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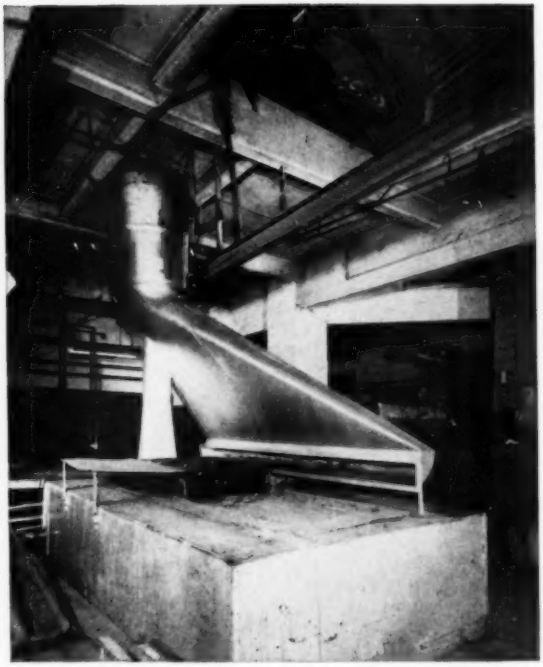
in *Cincinnati*... movement engineer makes a big difference



A battery of galvanizing tanks (one is shown at the right) in a Cincinnati plant was filling the air with noxious fumes and gases, even though the tanks were equipped with fan-powered canopies. Efficiency was reduced, production was slowed and the fumes became so bad that at times you couldn't even see across the room. Then the nearby Hartzell field engineer was called in. He studied the problem, calculated the need and prescribed a slot-type duct at the back of each tank, powered by a Hartzell ND28-6A-BDS duct fan. Immediately after the Hartzell installation the fume problem became a thing of the past.

Simple? Certainly. So was the original attempt, but *it* wasted money every hour it operated. In some cases, of course, a slot-type hood installation would be unsatisfactory; if friction loss is not calculated correctly, fumes will escape; if *both* air volume and speed are not close to the ideal, results will be bad. But you don't need to worry about these problems when you call in your nearby Hartzell field engineer. His experience, backed by the home office engineering laboratories, can help you *know* you'll get the *right* fan or blower and the *right* installation to give you the results you want.

The installation described above was handled by the Hartzell Field Office at 2712 Erie Avenue, Cincinnati 8, Ohio. Telephone East 4463

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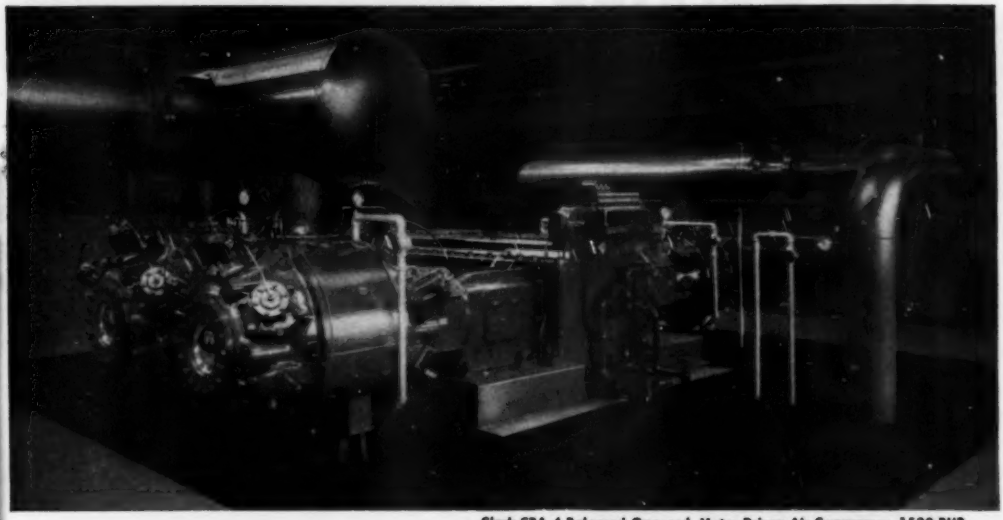

Clark CBA-4 Balanced-Opposed, Motor-Driven Air Compressor. 1500 BHP. 8400 CFM. Discharge pressure 100 psig. Location: Michigan.

. . . in supplying plant air for a major auto manufacturer

One compressor that does the job of several . . . compactness that's economical of space . . . vibration-free operation that simplifies foundation requirements . . . these are the decisive points that prompted a major auto manufacturer to replace many smaller units with one Clark Balanced/Opposed, Motor-Driven Air Compressor. And now, as proof of performance, two additional units will soon be delivered to effect further economies for this famed builder of quality cars.

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INDUSTRY AND POWER

VOLUME 62 **APRIL, 1952** NUMBER 4

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Acorns of science

Developments not yet available, but of interest to those responsible for Engineered Plant Services

Temperature Indicating Paper

● A coating that can be designed to melt at any given temperature has been developed by the Army Quartermaster Corps. The white pigment coating on black paper melts into the paper base when its specified melting point is reached, leaving a black background. Instant temperature readings between 115 and 500 F are possible.

Temperature indicators based on color changes have been used for several years; are not suitable for reading by color blind persons. This fault is avoided in the black and white indicators. Materials required are readily available and commercial production should bring cost down to a few cents each for the thermometers.

Wide Range Grease

● One of the wide temperature range greases, a copper phthalocyanine lubricant, under development by the Naval Research Laboratory now has a use range from -80 to 400 F. Tests on the high temperature bearing test machine show satisfactory operation for 1000 hr at 425 F.

More About Transistors

● A new version of the transistor, or germanium amplifier, has been unveiled by the Radio Corporation of America. This unit of the point contact type is made by embedding the elements in a thermosetting resin and will resist shock and elevated temperatures and can operate at -180 C. It has two closely spaced fine wires in contact with a speck of germanium.

Because of ability as an amplifier, lack of filament, low power requirements and small size, interesting predictions have been made for its use. Included are compact portable computers, vest-pocket radios the size of a cigarette package, a batteryless, watch size radio which may operate on power furnished by heat of the body, and a radio receiver-transmitter smaller than a telephone handset.

High Voltages Regulated

● Patent 2,579,223 describes a source of high d-c voltage and provides a high voltage power supply characterized by high stability and degree of regulation in the presence of sharp changes in load conditions. Frequency modulation is employed in the regulating loop; regulation is performed at the ungrounded end of the power supply. The regulation sample voltage is derived at the low end of the regulated voltage supply output.

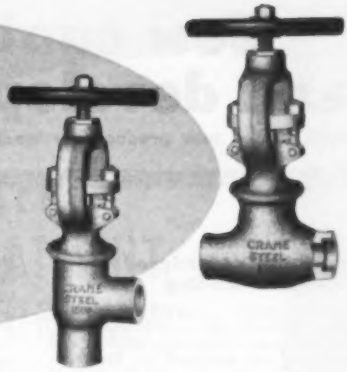
Another patent, 2,585,679 also discloses a high voltage d-c regulator stable over a wide range of load conditions. Polarity may be reversed. Radio frequency coupling is employed in combination with an amplifier to control operation of a regulator tube.

Plastic Piping Tests

● Now being installed in new minesweepers built for the Navy, plastic piping will save about two ton of copper per ship; costs about $0.70 per ft for the 2 in. size compared to $1.55 for copper-nickel and $2.25 for stainless. The pipe is made of glass fiber cloth bonded with synthetic resin, can be patched with glass fiber tape impregnated with plastic.

In an 8 month test aboard a destroyer escort, plastic pipe held up where metallic piping gave way due to corrosion, shock and vibration.

NEW CRANE
SMALL STEEL VALVES
WITH *REVOLUTIONARY* LIP-SEAL
(PATENTED)
BONNET JOINT
1500 AND 2500-POUND CLASSES



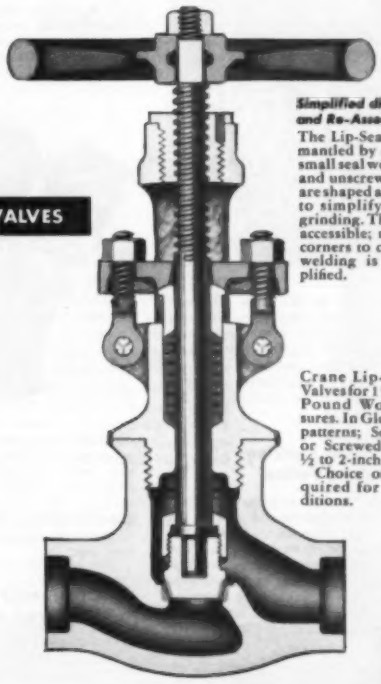
Look closely at the Lip-Seal Bonnet joint of this new Crane small steel valve. A small bead of weld metal seals the joint against leakage—yet the entire mechanical load, both pressure and stem thrust, is carried by strong threaded members.

Here is bonnet joint improvement that brings you important benefits beyond tight sealing and freedom from maintenance.

For example, Crane Lip-Seal design permits a weight-saving, more compact structure without sacrificing strength or reducing seat area. It combines significant developments for improved flow control, ease of operation, and durability. Add to these the ease with which the Lip-Seal joint may be dismantled and re-assembled—and you have a valve with outstanding suitability for your high-pressure/high-temperature power service needs.

DESIGNED AND TESTED TO GIVE YOU:

- **Absolute Tightness**
- **Freedom From Bonnet Joint Maintenance**
- **Minimum Weight and Bulk**
- **Easier Dismantling and Re-Assembly**



Simplified dismantling and Re-Assembly

The Lip-Seal joint is dismantled by removing the small seal weld on the lips, and unscrewing. The lips are shaped and positioned to simplify removal by grinding. They're entirely accessible; no pockets or corners to clean out. Re-welding is equally simplified.

Crane Lip-Seal Bonnet Valves for 1500 and 2500-Pound Working Pressures. In Globe and Angle patterns; Socket-welding or Screwed Ends. Sizes: ½ to 2-inch.

Choice of Steel as required for service conditions.

YOU GET FEATURES LIKE THESE IN LIP-SEAL VALVES

SWIVEL DISC-STEM CONNECTION—Minimizes vibration—provides long pilot guiding for disc. Design makes a more rigid—yet swivel-free—connection.

FULLY GUIDED STEM—Smoother, easier to operate. Fully guided by long yoke bushing and long engagement with lower end of bonnet. Gives positive, straight-line seating.

TWO-PIECE BALL-TYPE PACKING GLAND—Assures uniform load on packing. Prevents binding on stem even when nuts are not pulled up equally.

DURABLE PLUG-TYPE DISC—Has wide seating contact not easily damaged by foreign matter or by wiredrawing. Taper of disc permits close flow regulation while throttling.

STELLITE-FACED SEATING SURFACES—Effectively withstand corrosion and erosion; highly resistant to wear, seizure, galling, and abrasion. Seat is integral with body.

EASY ACCESS TO STUFFING BOX—Ample space within yoke legs allows convenient re-packing. The swinging type gland eye-bolts swing completely clear.

The Complete Crane Line Meets All Valve Needs. That's Why,
More Crane Valves Are Used Than Any Other Make!

This Circular Ready For You

Your copy of this 8-page booklet supplied free on request. Gives complete information on Lip-Seal Valves, including materials, service recommendations, sizes, and dimensions. Ask your Crane Representative for a copy or write direct.

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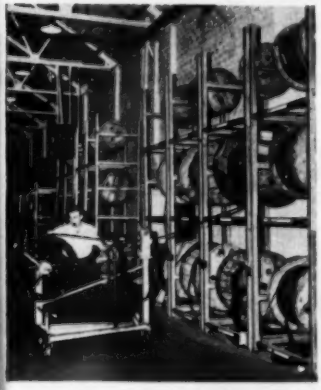
1—Reel rack is designed for efficient handling

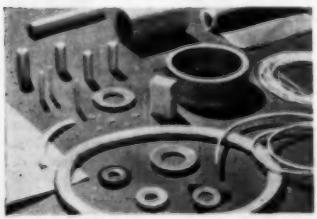
Storage space is conserved and handling reels of materials such as cable, loom, wire, tubing and rope is made more efficient with a stacking rack developed by Equipment Manufacturing, Inc. The reel is placed in the rack at floor level. The axle is located



by "U's" provided on the cross members. Reel and rack are then handled as a unit by lift truck. Welded square tube construction is featured, with self-aligning nesting feet that make stacking sure and easy. Each reel is free to rotate independently so that lengths of material can be dispensed readily as needed.

2—Gaskets and packing are made of Teflon

The Flexrock Co. has announced a complete line of Teflon gaskets and packing, as well as sheet, tape, cylinder, rod, tube, bar stock and special machined shapes. The packing is furnished lubricated or unlubricated in endless rings and in continuous braided construction. Gaskets are supplied in jacketed construction, or as solid ring gasket and special shapes. Teflon, which



offers an unusual combination of properties, is completely inert chemically, has high mechanical and impact strength, excellent dielectric properties, zero water absorption, and is serviceable from -150 to 550 F. In addition, it has a naturally slippery anti-adhesive surface.

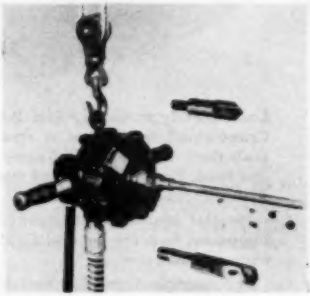
3—Engine features compact design

Model K90, a compact 3.6 hp, 3600 rpm engine, has been announced by Kohler Co. Weighing only 44 lb, it features compactness, portability, power and easy starting. Besides being ideal for equipment requiring ample power in compact space, mounting dimensions also permit its use as a replacement on existing equipment. Among the design features are anti-friction ball bearings at both ends of the crankshaft and easily accessible breaker points which are

dustproof, moisture proof and externally mounted for speedy servicing. The ignition system operates from a high voltage crankshaft magneto which insures instant starting. The engine is also available for direct mounting with threaded crankshaft or as a unit equipped with a 6 to 1 reduction gear.

4—Condenser cleaner has improved control system

Suspension-type condenser cleaners designed for cleaning small straight tubes have been developed by the Lagonda Div. of Elliott Company. With the proper selection of cleaning tools, they are equally efficient in removing either hard or soft deposits. In operation, they are supported from overhead by trolley, rope-block or hanger. Two ball type thrust bearings are used to absorb the forces imposed during operation. An improvement in the control system is a squeeze trigger located at the base of the right hand operating handle. Although convenient for the operator, it is not in a position to be opened accidently.



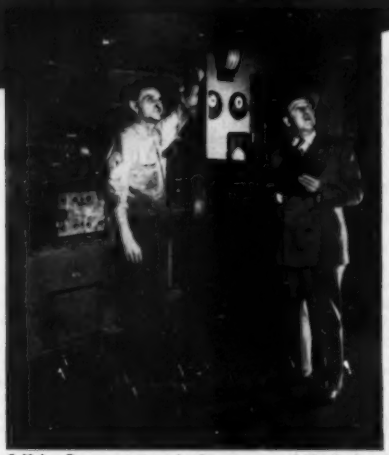
It actuates a throttle valve which can be regulated from off to wide open. Flow of cooling water or solvent is also actuated by the trigger. The units may be obtained as either air operated or electrically powered. Two drill heads have been designed for use with the units; for softer deposits as shown in upper right of illustration, and carbide-tipped for harder deposits as shown below.

5—Cageless bearing has self-aligning rollers

Roller bearings utilizing grooved rollers and a guide rail have been introduced by McGill Manufacturing Co. Alignment of the rollers at right angles to direction of travel is maintained by the guide rail. Like a lever in balance, any shift off-center causes contact between roller and rail, instantly returning the roller to the true axis. This design increases load capacity in two ways. Increased axial rigidity, especially important in single unit applications, is gained because the rollers make effective race contact virtually to the outside edges of the races. In addition, without cages a full

complement of rollers is permissible, thereby assuring maximum capacity. Open end construction permits a free circulation of lubricant which sets up a flushing action inside the bearing. Known as Guiderol, the bearings may be mounted in any position. They are available in sizes interchangeable with needle roller and cylindrical roller types, as well as single and double row ball bearings.

(Continued on page 10)



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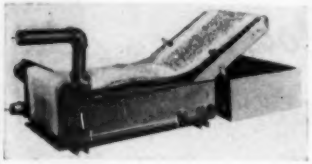
SYSTEM . . . Serving Industry through Practical Applied Science

New equipment and developments

(Continued from page 8)

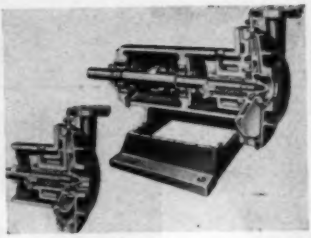
6—Automatic filter features continuously rotating web

Houdaille web type filter, for use wherever mineral or soluble oil coolant is used, is designed to serve industrial machines or small central coolant systems. This unit, designed by Honan-Crane Corp., features a self-cleaning, continuously rotating filter web. The unit is available in capacities from 40 to 500 gpm. In operation, contaminated coolant flows over the belt surface by gravity or system pressure. The liquid passes through the web, leaving the solids. As the web passes over a chip pan, special beaters thoroughly shake out all particles of contamination. Web speed can be varied to meet the volume of coolant flow. Degree of filtration may also be varied.



8—Pump handles corrosive and abrasive liquids

Peerless Pump Div., Food Machinery and Chemical Corp., has introduced a chemical process pump, Type DS, designed with special emphasis on corrosive and abrasive liquids with solids in suspension up to 5 per cent by volume. It is available with discharge sizes from 1 to 6 in., and with either enclosed impeller design, as shown in upper right of illustration, or open impeller, as in lower left. Capacities with enclosed impeller are to 600 gpm, and with open impeller to 1000 gpm, both operating against heads to 231 ft. Driver is a standard horizontal electric motor mounted on common base with the pump. It is offered in two basic designs; grease lubricated for temperatures to 250 F, and oil lubricated for temperatures to 600 F. Cooling coils are provided in the oil lubricated design for maintaining oil supply at proper temperature, and provision is also made for water cooling and packing. Liquid ends can be made of any required alloy, depending on intended service.



(Continued on page 14)

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7—Fhp motors are smaller, lighter, more versatile

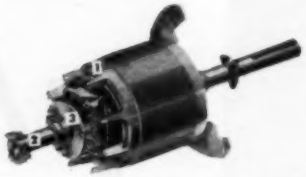
Fractional horsepower motors incorporating many radically different and advanced design features have been announced by the Fractional Horsepower Motor Dept. of General Electric Co. Designated as Form G, they are the result of nearly a decade of research and engineering.

Among the long list of completely redesigned features are new bearings, lubrication system, insulation, ventilation, mountings, windings, end shields, terminal board, and leads. A completely new insulation system is used, consisting of special nylon material scientifically combined with Formex wire and Glyptal varnish. In addition, the new motors are engineered for dissipation of heat losses while retaining outstanding performance in comparison to their small size.

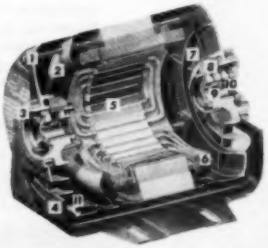
Lighter weight is stressed, some types weighing as much as 51 per cent less than former models. They are also considerably smaller in size. Another important advantage is increased versatility which permits a wider range of applications. The new sleeve bearings absorb more thrust and may eliminate the need for end play adjustment. The new motors are recommended for operation in any position.

Four types are available in either open dripproof or totally enclosed fan-cooled models. Polyphase type K delivers constant speed for all standard applications where two or three phase power is used, such as pumps, compressors, fans and blowers. Capacitor start type KC is recommended for commercial refrigeration, air conditioning compressors and motorized tools where starting torque under heavily loaded conditions is required. Split phase type KH is for fans, blowers, centrifugal pumps, appliances and other general applications where moderate starting torque and quiet smooth performance are needed. Permanent split capacitor type KCP is for shaft-mounted fans and blowers where quiet, multi-speed operation under constant load is desired.

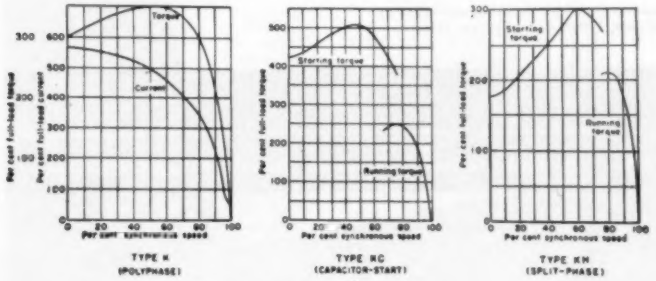
Although pared down to the essential, the new motors conform fully to NEMA specifications. They will be offered in a complete range of standard horsepowers, speeds, voltages and frequencies.



1. Aluminum rotor winding made by vacuum pressure casting—produces denser winding for uniform performance. Ventilating fins cast integrally with winding
2. Locking device holds rotor in place
3. Centrifugal mechanism pressed on shaft maintains alignment and assures proper contact spacing for smooth positive action



1. Lightweight steel shell with phosphatized surface for corrosion protection
2. Baffle ring separates ventilating air
3. Ring pressed on bearing nose to isolate noises
4. Steel cradle base and locking latches maintain alignment and support all-position mounting
5. Stator core of welded construction
6. Unified insulation system is extra strong and resistant to heat, aging, and other deteriorants
7. Flat, disc-type end shields have rabbet and bearing surfaces in same plane
8. Felt wickings in oil reservoir
9. Sleeve bearings for operation in any position
10. External oil thrower prevents oil from escaping
11. Ventilating openings for free air movement



TYPE K (POLYPHASE) TYPE KC (CAPACITOR-START) TYPE KH (SPLIT-PHASE)

TYPICAL SPEED-TORQUE CURVES

Modern power plant practice demands a water conditioning program that produces only the ultimate in trouble-free and efficient boiler operation.

External softening and the use of conventional inorganic treatments are recognized requisites. However, the supplementary use of organic agents may well assure the difference between long, uninterrupted operation and frequent boiler outages due to scale and sludge formations.

Take the case, for example, of a large electrical manufacturer, who called in Betz 14 years ago to treat its new power plant. This plant operates at 900 pounds pressure with 50% make-up polluted river water. Betz recommended the use of organic agents to supplement the external softening and inorganic treatment.

Here are the results from the record: In the entire 14 years operation of these boilers, they have never been turbined or acid cleaned and no difficulties from feedwater conditions have occurred! What's more, excellent steam purity is produced and turbine blading is completely clean.

This plant could easily be your plant—operating efficiently, free from frequent boiler outages through the effective use of Betz *Specialized* Water Conditioning Service. Why not call on Betz today for an interesting discussion of your water problems? There's no obligation, of course. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

Send today for Betz Technical Paper No. 98, "Boiler Scale—Its Formation and Prevention." It's free.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

The VU Story

revealing the breadth of C-E's current

When you buy a boiler the manufacturer's long experience is a very important consideration, and Combustion has that. But even more significant is *current* experience . . . experience in meeting steam requirements similar to yours. And Combustion has that, too.

Here is a comprehensive picture of contracts placed for C-E Vertical-Unit Boilers during 1951. What it adds up to is that VU Boilers have nationwide and worldwide acceptance . . . that 1951 contracts represent a full range of capacities, pressures and temperatures and virtually every fuel and method of firing.

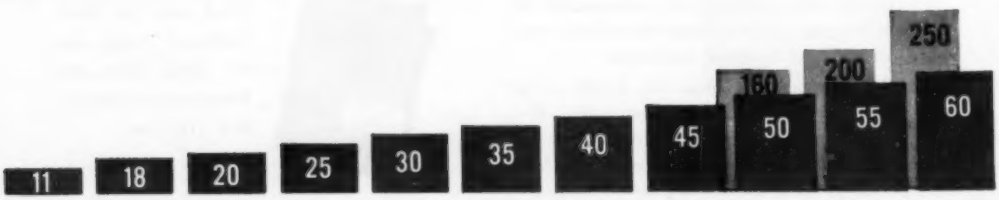
So you can select a C-E Vertical-Unit Boiler with complete assurance that your installation will not only reflect Combustion's long experience—more than 20 years—with the basic VU design but will also reflect C-E's comprehensive *current* experience in applying this design for conditions identical to yours.

Additional information on 1951 VU contracts

FUELS AND FIRING—Bituminous coal as supplied from all principal mining areas; also anthracite, lignite, oil, gas, bagasse, bark, wood and various refuse fuels. All present-day methods of firing and types of firing equipment are represented including combination firing of two or more fuels.

GEOGRAPHICAL—Units ordered during 1951 will be installed in 27 states, in seven Latin American countries and in Africa, Arabia, Australia, Canada, Israel and Spain.

INDUSTRIES—Automobile, Brewing, Building Materials, Cement, Chemical, Food Products, Government, Institutions, Lumber, Machinery, Metal Mfg., Mining, Paper, Petroleum, Public Utilities, Railroads, Rayon, Rubber, Shipbuilding, Soap, Sugar and miscellaneous manufacturing. B-559



COMBUSTION ENGINEERING

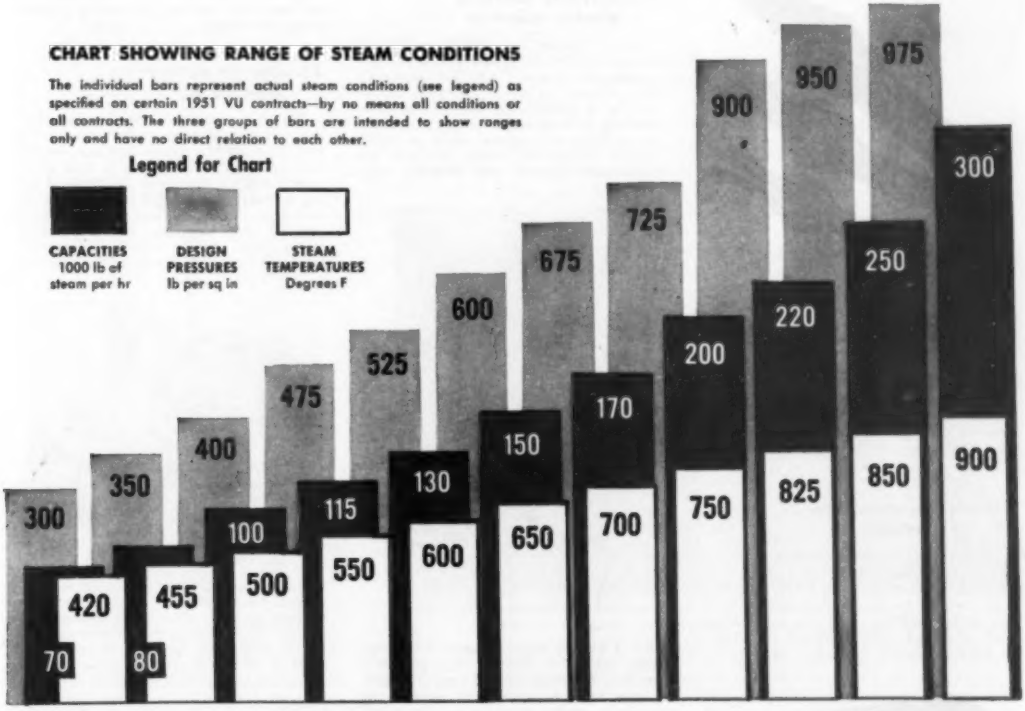
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS, ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

for 1951

experience in the application of C-E VERTICAL-UNIT BOILERS

CHART SHOWING RANGE OF STEAM CONDITIONS

The individual bars represent actual steam conditions (see legend) as specified on certain 1951 VU contracts—by no means all conditions or all contracts. The three groups of bars are intended to show ranges only and have no direct relation to each other.



— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

New equipment and developments

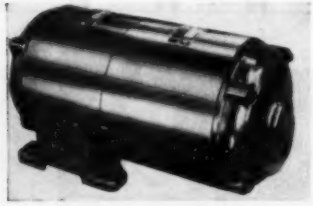
(Continued from page 10)

9—Cable protects control connection lines

Pneumatic and hydraulic control circuits may be streamlined through use of Armortube cable, a flexible, protected multi-tube transmission line, according to Bailey Meter Co. It is made up of ¼ in. OD aluminum or copper tubing gathered in a slow continuous spiral similar to the construction of rope. A tube bundle is wrapped in water-repellent insulating tape, and then encased in heavy rust-resistant galvanized steel strip like that used for BX electrical cable. The cable is designed to lower installation time and costs, save critical materials, protect instrument and control connecting lines, conserve space, and improve plant appearance. Available in bundles of 4, 8, and 12 tubes, it is capable of transmitting hydraulic control pressures as high as 3000 psig and all ranges of pneumatic control pressures. Connections may be made in standard electrical junction boxes, thereby eliminating expensive support racks.

10—Motor-alternator is portable

A 400 c motor-alternator manufactured by American Electric Motors is said to offer marked freedom from maintenance. The unit, which meets AN-E-19 requirements for power supplies, does not use rotating coils, does not require brushes or springs, is small in size and is unusally compact. The laminated motor is mounted with ball bearings. No other moving parts exist. The unit measures approximately 22 x 12 x 12 in., and weighs 125 lb. This feature, which makes the unit readily portable, eliminates many problems involved with remote, permanent installations. The units are furnished with outputs to 1000 w for single phase, and to 1800 w for 3 phase. Single or 3 phase common shaft motor drives are available. A wave form of unusual purity is obtained, having less than 5 per cent total harmonic content. Voltage regulation is to plus or minus 1 per cent. Output voltage is 115 for single phase and 115/200 for 3 phase.



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11—Burrette features plastic reservoir

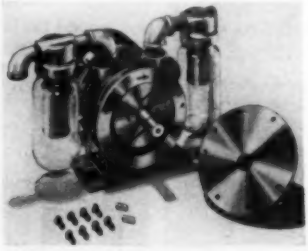
Only a squeeze is required to fill the automatic self-leveling burette of a unit announced by Hagan Corp. The Squeez-O-Matic features a plastic reservoir, in the form of a polyethylene bottle, which not only simplifies operation of the burette but also provides a container which is highly resistant to chemical attack and will not contaminate standard and nitrating solutions. A molded stopper is used to hold the burette rigidly in position and provide a firm seal. The base, made of a plastic highly resistant to both mechanical damage and chemical attack, provides a convenient platform for the receptacle being filled. The units are available in 10 and 25 ml sizes, graduated in tenths.

12—Compressors available as self-contained units

Schramm, Inc. has announced a new line of small industrial compressors ranging in size from ½ to 5 hp. Available models include the bare compressor with flywheel, the compressor on vertical or horizontal receiver, on a base with electric motor or on horizontal receiver with motor or gasoline engine. Features on the illustrated receiver mounted model include a large intake muffler with air filter, light water-type valves, air-cooling fan-bladed flywheel, V-belt drive, controlled lubrication and finned compressor cooling. This model also includes safety and outlet valves, pressure gage and switch.

13—Pumps deliver oil-free air

No oil is required in the pumping chamber of three air pump models now being built by Gast Manufacturing Corp. Instead, four vanes of carbon sliding in slots in the rotor lubricate themselves. Necessity of oiling is thereby eliminated, according to the manufacturer, and delivery of oil-free air is assured. Ball bearings are permanently grease-sealed, and a ventilated space between bearings and pumping chamber prevents grease from entering the latter. Centrifugal force seats the rotor vanes with constant pressure against the housing, resulting in unvarying performance at full rating. Vanes take up wear automatically. Since no oil film is used to seal against loss of vacuum or pressure, pumping characteristics are unaffected by temperature changes. Construction is simplified since there are no body or end plate spacer gaskets, shaft seals or lubricators. Applications include use on instruments and controls as well as any equipment where oil-free air is essential, such as paper-handling and food packaging machinery. Capacities are from 3.5 to 24 cfm. All models produce up to 20 in. vacuum, or to 10 lb pressure.



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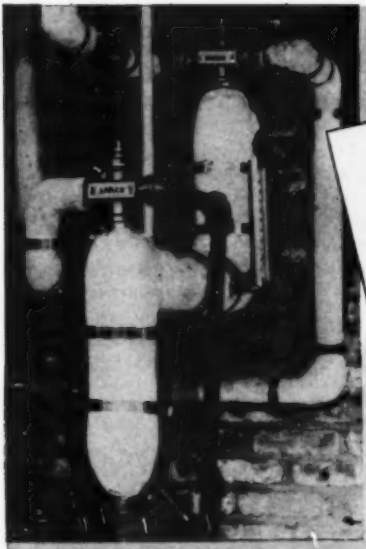


Sarco makes simple, self-acting temperature controls assuring the desired Jacket cooling effect with minimum water consumption regardless of load variations.

Sarco type TR-40-L Cooling Control-Jacket water temperatures never too hot or too cold.

Sarco type FA Drain Traps have four pressure ranges to 750 psi. Sizes: ¾" or 1".

The true measure of effective air compressor capacity is the useful work done by your compressed air.

Measured by this yardstick, many compressor installations are very much oversize for the work they do.

Apart from poorly designed piping, the trouble usually lies in wet air, overcooling, undercooling, choked intake filters, etc. All of these things add up to expensive compressed air and high maintenance costs.

New Technical Bulletin, No. 5-CA, is designed to help users and would-be users of compressed air to get more work from their machines at less cost.

Write for your free copy today.

Sarco type FA compressed air trap automatically removes separated water from the bottom of the receiver. This greatly reduces the possibility of water being carried down the distribution lines to cause trouble in the tools or at the air nozzles. This trap is also used to drain water from separators and the low points of distribution lines.

343

SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

Represented in Principal Cities

SARCO CANADA LTD., TORONTO 5, ONTARIO

Let it rain - Let it pour - High Moisture

This is typical of the experiences of RILEY "50" pulverizer users

"The mills and feeders are performing in a very satisfactory manner. We had a twenty-four hour rain and the coal was so wet, water ran back on the belts to the breakers. We had considerable trouble with some of our mills, the Riley's didn't seem to notice there was anything different about the coal. The test you ran here may not have been conclusive but after what we went through I believe you can quit thinking about moisture. It seems to have no effect upon your equipment."

An unsolicited letter from a large Midwest Public Utility

TRADE MARK Rx REGISTERED

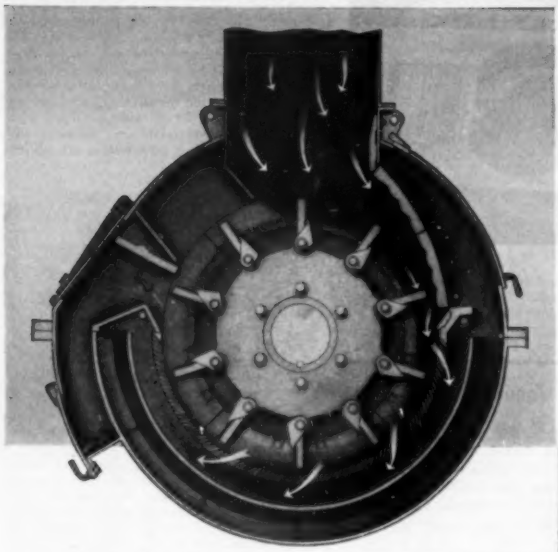
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Charlotte · Atlanta · New Orleans · St. Louis · Kansas City · St. Paul · Tulsa · Houston
Denver · Salt Lake City · Los Angeles · Portland · Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

makes no difference to RILEY "50" Pulverizers



Crusher-Dryer Section

The crusher-dryer section, the first stage of the new Riley "50" pulverizer evaporates all free moisture in the coal if adequate primary air temperatures are provided so that moisture has no effect upon capacity or power consumption.

The crusher-dryer section not only dries the coal but it also rejects all foreign materials and crushes the coal to a fine granular state—at least 40% will pass a 50-mesh screen. This section also eliminates possibility of damage to the pulverizer by foreign materials as no material larger than ¼" can enter the final pulverizing stage.

Parts faced with tungsten carbides

To minimize maintenance and to assure long periods of continuous operation with sustained fineness, pulverizing elements are faced with tungsten carbide. A six-ton per hour Riley pulverizer equipped with tungsten carbide parts in September 1948 has pulverized over 80,000 tons of coal with no falling off of fineness and with but slight wear of tungsten carbide facing. See illustration of new and used parts at right. The use of tungsten carbide has greatly reduced maintenance material costs and tremendously reduced maintenance labor costs.

Riley "50" Pulverizers give you all these other significant advantages . . . .

- Quiet vibrationless operation
- Explosion proof
- Flexibility—wide load range
- Ability to carry extremely low loads
- Low power consumption
- Ease of regulation
- Small space required
- Minimum foundation cost
- Parts easily renewed
- Can be operated without coal feed
- Ease of ignition
- Low lubrication cost
- No worms or gears—Just two bearings
- High primary air temperatures

The Riley "50" pulverizer is the latest development in the coal pulverizing field. It will pay you to thoroughly investigate this significant pulverizer development when considering additional coal pulverizing equipment.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

New equipment and developments

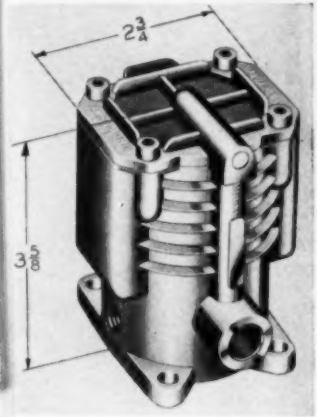
(Continued from page 14)

14—Coating prevents scattering of broken glass

Danger of glass particles from broken light bulbs scattering and injuring employees can be eliminated by coating the bulbs with Tecogel, a clear lacquer-type anti-fragmentation coating, according to the manufacturer. The coating, manufactured by Thompson & Co., is applied by hot-dipping. It sets in two to three minutes and dries hard in two to three hours. For best results it is recommended that the coated bulbs be allowed to dry for four or five hours before being put into service.

15—Solenoid pilot valves are self-cooling

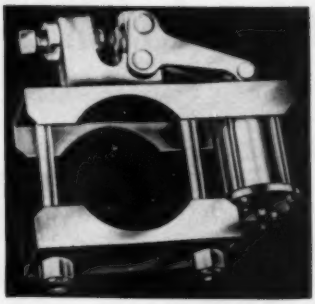
Solenoid pilot valves for use with air, vacuum, oil and water are announced by Valvair Corp. They are specially recommended as a pilot for cylinder or diaphragm operated valves. The coil, completely sealed



from the controlled fluid, is self-cooling and will not overheat on constant duty. Long life and dependable servite are claimed for the units. Using only a plunger and a spring, a minimum of moving parts are featured. Standard units are available as two, three or four way valves for 110, 220, or 440 v, 60 c current. Current consumption is 26 w for inrush and 20 w for holding. The ¼, 3/8 and ½ in. size cylinder valves can be operated up to 300 cycles per minute, and the ¾ and 1 in. sizes up to 150 cycles per minute.

16—Clamp simplifies attachment of vibrators

An air operated mounting clamp designed to speed up attachment of external vibrators has been developed by Viber Co. This unit is especially advantageous when only short periods of vibration are required. Air pressure used by the vibrator is applied first to the clamp. This actuates jaws which grip



securely to a suitable steel member such as an exposed angle. The air pressure may then be applied to the vibrator.

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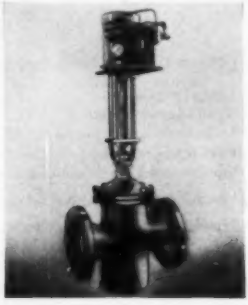
17—Throttling valve solves difficult control problems

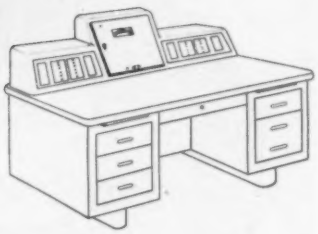
Throttling control valves, developed by Conoflow Corp. and Paul Valve Corp., combine Conoflow pneumatic cylinder operators with Paul venturi ball valves. The manufacturers state that the combination of these units greatly simplifies many difficult control problems involving corrosive fluids, abrasive materials, high temperature and high pressure applications and other difficult services. The cylinder operator utilizes



a positioning mechanism as a component part, and therefore can be used in conjunction with pneumatic control instruments for automatic control or with manual loading stations for remote control. Streamlined venturi passages and smooth surfaced ball provide a non-turbulent flow stream to eliminate cavitation, increase capacity and improve controlability. A straight line relationship between valve lift and flow makes the unit suitable for throttling control service. The valve is available in sizes to 8 in., and in a variety of materials.

18—Desk simplifies reading of many processing points

A console desk, manufactured by Brown Instruments Div. of Minneapolis-Honeywell Regulator Co., now makes it possible to obtain temperature readings for as many as 96 processing points without constant walking from one end of a long or divided panel board to the other. It is an executive-type office desk, 60 in. wide, arranged with cutouts to accommodate an indicator and key switch banks or push-button assemblies.



Sheet metal construction is used with drawers and desk-top writing space in conventional arrangement. The desk can be used in any large control room and can be tied in with any single, multiple or Colorgraphic panel board.

19—Small volt-ammeter measures high amperage

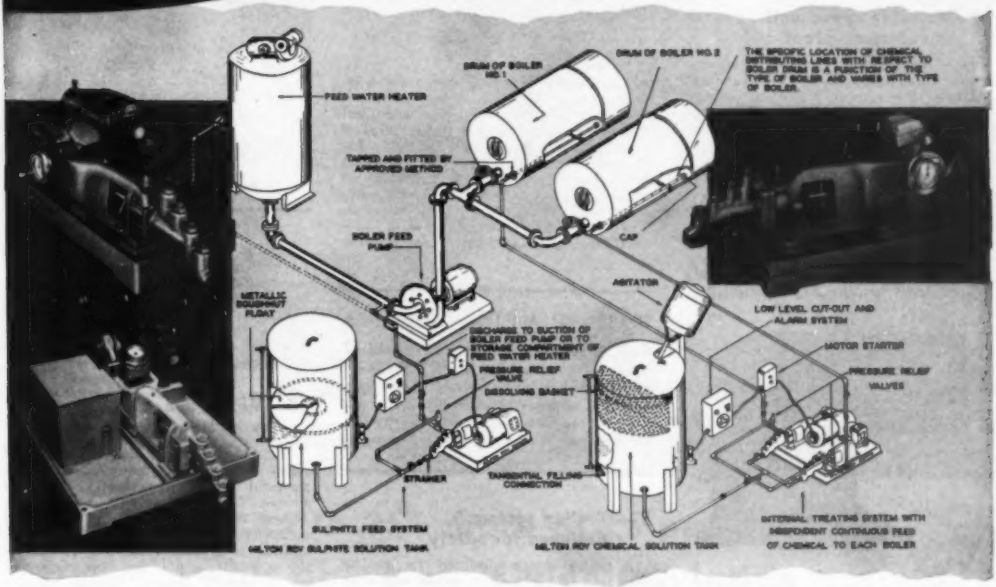
Pyramid Instrument Corp. has introduced a high current volt-ammeter that measures up to 1200 amp, yet can be carried in the coat pocket. Known as the Amprobe Model 1200, it is of the snap-around type. Current is measured without being connected to the conductor, and therefore without interrupting the circuit or shutting down equipment. A newly developed doughnut type transformer eliminates, for all practical purposes, the factor of error due to position of conductor within the probe jaws. Incorporated in one a-c instrument are six ammeter ranges (0-15/60/150/300/600/1200 amp), and three voltmeter ranges (0-150/300/600 v). Voltage test leads are equipped with a safety-type plug which automatically insulates itself when removed from the meter. Probe jaws are completely insulated down into the sockets to eliminate danger of shorts while working in crowded switch boxes and distributing panels. A wide-angle, high-visibility window makes it possible to take

a quick accurate reading from practically any position, even in poor light. The instrument is 8½ in. long and weighs 15½ oz. It has a large d'Arsonval jeweled movement with Alnico magnet, precision balanced and completely dustproofed.

(Continued on page 20)

This is Controlled Volume Pumping

Continuous automatic treatment of boiler feed water, involving precise metering of chemicals: di-sodium phosphate directly into the boiler drum; sodium sulphite to the suction end of the boiler feed water pump; sodium hydroxide to the raw water inlet line—for pH control. Result: Boiler feed water chemically treated to prevent deposit of scale forming solids or corrosion in the system.


FEED WATER HEATER
DRUM OF BOILER NO. 1
DRUM OF BOILER NO. 2
THE SPECIFIC LOCATION OF CHEMICAL DISTRIBUTING LINES WITH RESPECT TO BOILER DRUM IS A FUNCTION OF THE TYPE OF BOILER AND VARIES WITH TYPE OF BOILER.
TAPPED AND FITTED BY APPROVED METHOD
CAP
BOILER FEED PUMP
AGITATOR
METALLIC EQUIPOISE FLOAT
LOW LEVEL CUT-OUT AND ALARM SYSTEM
MOTOR STARTER
DISCHARGE TO SUCTION OF BOILER FEED PUMP OR TO STORAGE COMPARTMENT OF FEED WATER HEATER
PRESSURE RELIEF VALVE
PRESSURE RELIEF VALVES
DISSOLVING BASKET
STRAINER
TANGENTIAL FILLING CONNECTION
SULPHITE FEED SYSTEM
MILTON ROY SULPHITE SOLUTION TANK
MILTON ROY CHEMICAL SOLUTION TANK
INTERNAL TREATING SYSTEM WITH INDEPENDENT CONTINUOUS FEED OF CHEMICAL TO EACH BOILER

THIS MILTON ROY BOILER WATER TREATMENT SYSTEM DOES THE JOB

This typical Milton Roy "packaged" system is at work in a large Eastern steam electric station. A total of ten Milton Roy Controlled Volume Pumps currently perform their precise operations in the automatic chemical feed system. As boilers are added to increase plant capacity, additional pumps are likewise added and correlated with the existing system. To precipitate calcium and prevent scaling, 12.2 gallons per hour of 3% di-sodium phosphate are pumped directly against a pressure of 2,000 psi into the boiler drum. Sodium sulphite, 3 gallons per hour in 5% concentration is pumped proportionately against a maximum pressure of 100 psi to the boiler feed water to remove oxygen. For precipitation of magnesium and for automatic pH control, a Milton Roy Controlled Volume Pump meters up to 3 gallons per hour of 5% sodium hydroxide at 100 psi, as called for by the pH control system, automatically setting the stroke length of this pump.

Proportional feed of treating chemicals to boiler feed water, utilizing automatic control devices to assure positive controlled volume metering, is typical of thousands of similar world-wide installations engineered by Milton Roy. Quantities of chemicals handled vary with the demands of the installation. Power men recognize in Milton Roy equipment the unvarying accuracy and dependability so vital a part of uninterrupted power generation.

Milton Roy supplies systems for all forms of internal and external water treatment—handling all treating chemicals—to meet all pressure and capacity requirements. Write to our engineers for complete information, or consult your classified 'phone directory for your nearest Milton Roy representative.

Manufacturing Engineers

WITH THE EXCLUSIVE STEP-VALVE DESIGN

MILTON Roy COMPANY

1319 EAST MERMAID LANE, PHILADELPHIA 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

New equipment and developments

(Continued from page 18)

20—Variable speed unit is explosion-proof

With the broadened application of variable speed in many industries, demand has developed for a motor which can operate in dangerous locations. A combined explosion proof Varidrive motor has been designed by U.S. Electrical Motors, Inc. to meet this requirement. The motor unit is mounted on the Varispeed assembly to form a self-contained unit, occupying a single base. This feature saves space and eliminates intermediate connections. The motor element is totally enclosed and air movement is blasted over the enclosed unit from the exterior by a spark-proof fan housed within the end sector. By turning a control dial,

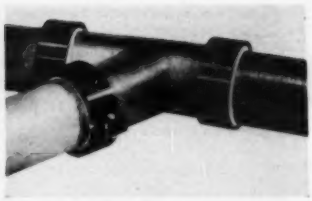
change in speed is provided instantly. The motor is available in output speeds from 2 to 10,000 rpm in ratings from 1 to 20 hp. When required, gear reductions are incorporated as an integral unit of the drive.

21—Push button switch controls power scoop

The Jeffrey Manufacturing Co. announces an automatic power scoop for unloading bulk material from box cars. Operation is by an electric push button switch built into the handle. This provides positive control as well as greater safety in operation. Forward movement is started by pushing and holding the button while gripping the handle, and is stopped by releasing it. When pulling the scoop back, the cable is unreeled only the required length, so that there is no slack interfering with operation. It therefore can be moved backward and forward at will before moving material to the door for discharging. One man can easily handle the complete operation, since the scoop is light in weight and requires little effort to pull backward. Cable reel is direct driven by a 5 hp motor.

22—Leak-proof joint for clay pipe is threaded

Combination of plastic and vitrified clay to form a leak-proof, infiltration-proof joint for industrial clay pipe has been developed by The Robinson Clay Products Co. Premium grade clay pipe is manufactured with a male-threaded polyvinyl chloride Plastisol casting at each end. A phenolic plastic collar with matching female threads fits onto the stationary pipe, and



the next length of pipe is then screwed into the collar. For installations where it would be difficult to screw additional lengths into place, a split-flange union is available which bolts tight at the sides. Known as Screw-Seal, this joint is resistant to most acids and gases, is satisfactory to temperatures up to 130 F, and can withstand backloads of 2000 lb per linear ft. The pipe and joints, available in 4, 6, and 8 in. ID, are rated to 20 psi service pressure.

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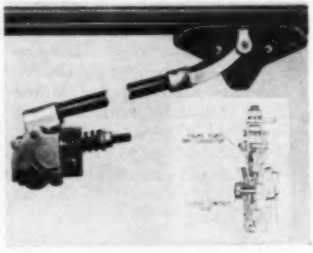
23—Trolley system is designed for safety

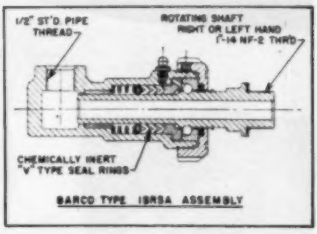
A trolley system designed to insulate bare figure-8-bar conductors for maximum safety is now being marketed by the Benbow Manufacturing Co. Trade marked Insul-8-Bar it can be applied quickly and



easily to existing conductors without dismantling, or installed as a completely new system. Basically, the system consists of two units; a sheath of insulation material which can be readily cut to any desired length and snaps over the 8-bar conductor, and a sliding shoe collector which is held against the insulated conductor by adjustable spring action. The shoe makes contact through a continuous narrow opening at the bottom of the insulation sheath.

24—Revolving joint connects to rotating machines

A light-running revolving joint for air or hydraulic connections to high speed rotating clutches, chucks, and similar equipment is announced by Barco Manufacturing Co. The joint features chemically inert "V" seal rings which have a low friction coefficient, are little affected by increases in pressure and are remarkably free from scoring tendencies. Connection to rotating part is made by screwing the male threaded steel shaft of the joint into the hub of the chuck or clutch. The joint is offered with


1/2" ST'D. PIPE THREAD
ROTATING SHAFT RIGHT OR LEFT HAND 1-14 NF-2 THRD
CHEMICALLY INERT "V" TYPE SEAL RINGS
BARCO TYPE 1BR3A ASSEMBLY

either right or left hand 1-14 NF-2 straight machine threads. Connection to the stationary end may be standard ½ in. pipe or flexible hose. Overall length of the joint is 6 9/16 in. with wide spacing between bearings. It is suitable for use at temperatures to 425 F, and speeds to 1800 rpm, or more under certain conditions.

25—Mercury lamp is highly efficient

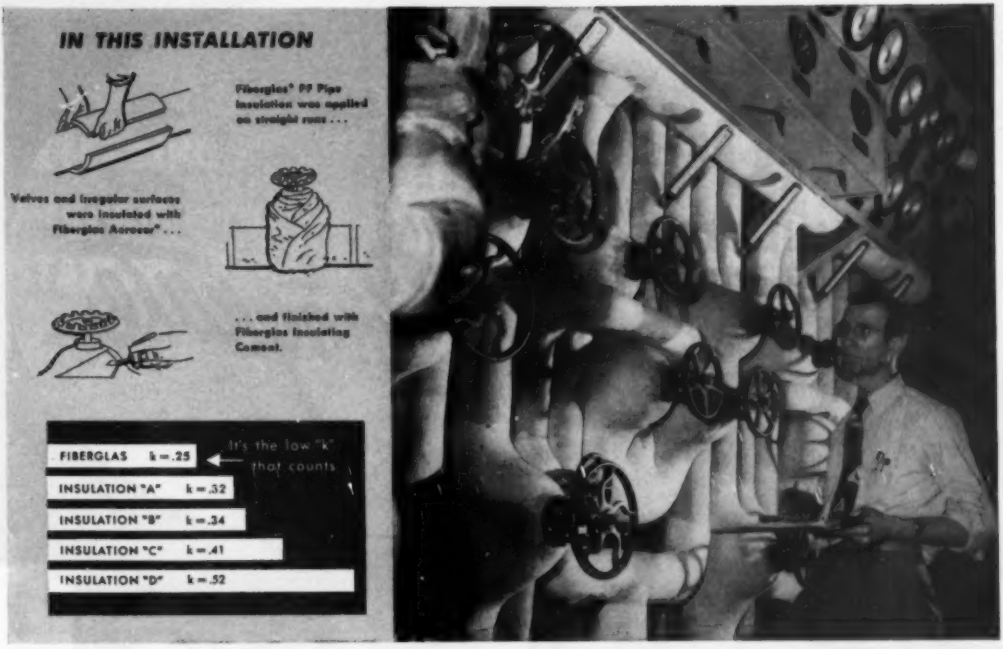
Demand for more light in industrial plants has resulted in the introduction of a powerful new mercury lamp by General Electric. Designated as A15, it is a highly efficient 1000 w mercury lamp for general industrial use where medium or high bay lighting is desired. Producing 52 lumens per watt, the lamp is the most efficient of the company's general lighting mercury lamps. Life rating is 3000 hr at 5 burning hr per start, and 4000 hr at 10 burning hr per start. Operation is satisfactory in any burning position. It is made to operate on 440-480 v for highest efficiency. This voltage also makes it possible to operate with a simple low-cost ballast, according to the company. The lamp has an over-all length of 14¼ in., and its heat-resistant outer bulb is 3½ in. in diam.

26—Motor and brake are integrally mounted

Motors with integrally mounted Stearns magnetic brakes are announced by Doerr Electric Corp. The motor illustrated is a ¼

hp motor on the 56 frame series. Similar designs are available on motors up to and including the NEMA 254 frame. Both open and enclosed motors can be furnished in either single or three phase. A new line of right angle, fractional horsepower gear motors is also available with motor mounted brakes.

(Continued on page 26)


IN THIS INSTALLATION
Fiberglas* PF Pipe Insulation was applied on straight runs . . .
Valves and irregular surfaces were insulated with Fiberglas Aeroseal* . . .
. . . and finished with Fiberglas Insulating Cement.
FIBERGLAS k = .25
INSULATION "A" k = .32
INSULATION "B" k = .34
INSULATION "C" k = .41
INSULATION "D" k = .52
It's the low "k" that counts

Save up to 25% more BTU's per dollar with Fiberglas PF Pipe Insulation

It's the "k" that counts. Fiberglas* PF Pipe Insulation is first in efficiency among molded materials for service up to 450° F. As the little chart above shows, the low heat conductivity "k" of Fiberglas Insulation gives superior protection when equal thicknesses are used . . . or in many cases you can use less thickness than with other insulations to obtain equal protection. Either way your costs are lower.

Fast, easy application is another way Fiberglas PF saves money. Available with canvas jacket for indoor use, or with weatherproof jacket for outdoor. *New form* is Fiberglas Dual Temperature Pipe Insulation. Its laminated jacket provides an integral vapor barrier for indoor lines that carry hot water one season and cold water another; or for continuous low-temperature service.

Where heat or cold must be controlled, count on these unique features of Fiberglas Industrial Insulations to produce top results . . . in less time, at lower cost:

- High insulating value
- Light in weight
- Easy to cut and apply
- Economically priced
- Ageless, rotproof
- Non-corrosive
- Low moisture pickup
- Will not shrink

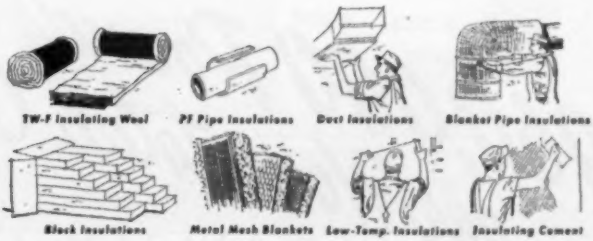
Your Fiberglas Insulation Contractor is ready to put these advantages to work for you. For his name, see the yellow pages of your phone book, or call the nearest Fiberglas Office. OWENS-CORNING FIBERGLAS CORPORATION, Dept. 94-D, Toledo 1, Ohio.

*Fiberglas (Reg. U.S. Pat. Off.) and Aeroseal are trademarks of Owens-Corning Fiberglas Corporation for products made of or with fibers of glass.

OWENS-CORNING FIBERGLAS

INDUSTRIAL INSULATIONS

...Where Heat or Cold Must be Controlled!



AT ROCKFORD

CENTRAL ILLINOIS ELECTRIC AND GAS CO.
Rockford, Illinois

It's Detroit Rotograte

Detroit RotoGrate Stoker ready for shipment to Sabrooke Station.

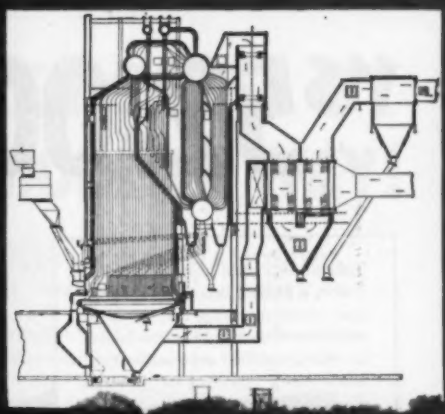
FOUR CONTRACTS FOR TWO STATIONS

Stone & Webster Engineering Corporation
Engineers and Constructors

960,000 Pounds of Steam per Hour total Capacity

Write for complete information on Det

EXTENDING FORDAM STATION



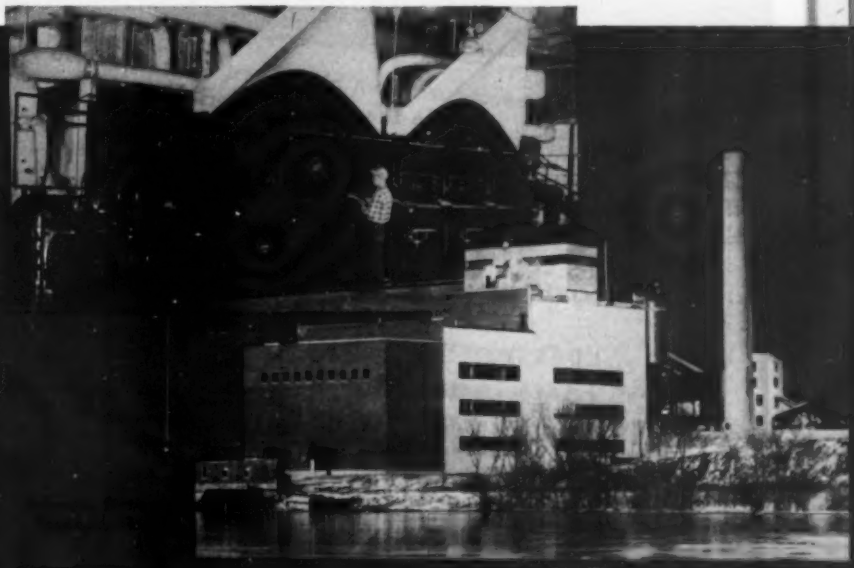
Detroit RotoGrate Stokers were selected for the new boilers in the Fordam and Sabrooke Stations at Rockford:

FIRST because they efficiently burn any type of bituminous coal. SECOND because of the lower investment necessary in equipment, foundations and building. THIRD because of lower power consumption to operate both stokers and auxiliaries and lower maintenance with a minimum of slagging difficulties in the furnace.

RotoGrate Stokers are modern spreader stokers with grates that move slowly forward, discharging the ash at the front. They permit high burning rates to produce more capacity per foot of furnace width.

At Rockford, as well as hundreds of other plants, they are operating at highest efficiency—with greatest satisfaction.

NEW SABROOKE STATION

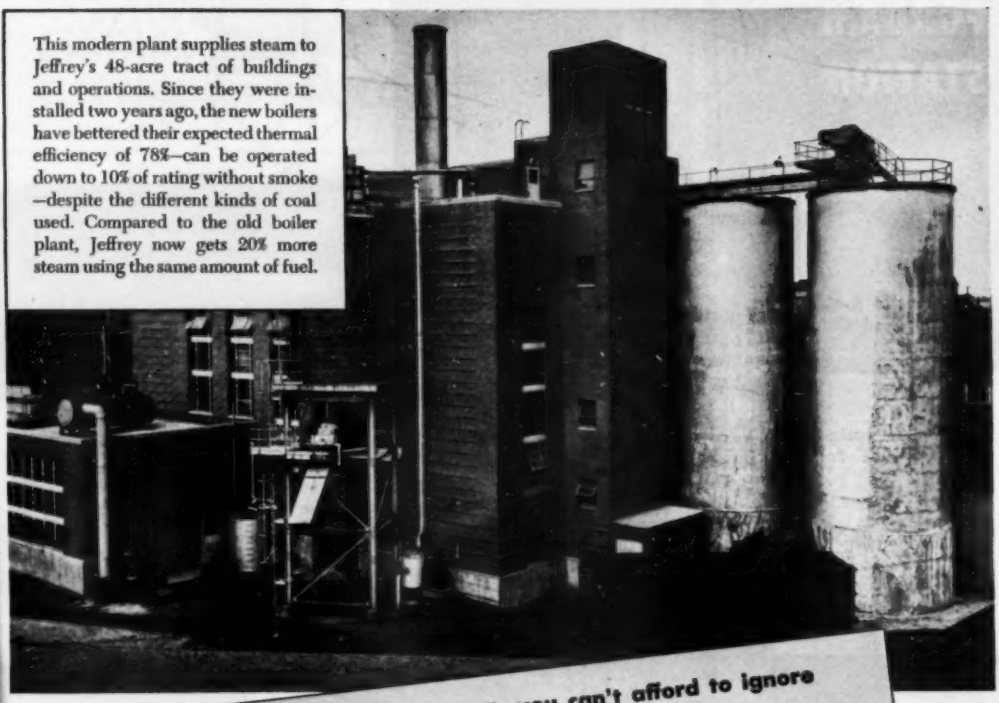


DETROIT STOKERS

DETROIT STOKER COMPANY

"$52,000 A YEAR-

This modern plant supplies steam to Jeffrey's 48-acre tract of buildings and operations. Since they were installed two years ago, the new boilers have bettered their expected thermal efficiency of 78%—can be operated down to 10% of rating without smoke—despite the different kinds of coal used. Compared to the old boiler plant, Jeffrey now gets 20% more steam using the same amount of fuel.



If you operate a steam plant, you can't afford to ignore these few down-to-earth facts!

COAL in most places is today's lowest-priced fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

THAT'S WHAT JEFFREY SAVES BY BURNING COAL THE MODERN WAY!

AUTOMATIC, DUSTLESS COAL HANDLING SAVES US $9,980 IN LABOR ALONE,"

says H. W. deBruin, Vice President in Charge of Manufacture, The Jeffrey Manufacturing Company, Columbus, Ohio

This enclosed screw conveyor delivers coal to the main bunker over the firing aisle. *The entire coal handling system can now be controlled by one man.* Compared to the old method, Jeffrey saves $6,080 annually in car-unloading costs alone. And ash removal is completely automatic and dustless, too—saves an additional $3,900.

The plant's firing aisle—showing the two-ton traveling weigh larry that delivers coal to the boilers. Steam generating costs, not including depreciation, are—**old plant, $.598 per thousand pounds . . . new plant, $.455 per thousand pounds. Total savings, including savings in coal handling, amount to exactly $52,904 annually!**

Handle coal efficiently, fire it properly, and you can save *big* money! Today, modern combustion and coal-handling equipment add greatly to ***bituminous*** coal's inherent economy. You can now get anywhere from 10% to 40% more power from each ton of coal than was possible a few years ago.

If you are planning to modernize your present installation, or if you're building a new steam-generating plant, call in a competent consulting engineer. He'll give you the facts—show you how it will pay you and pay you well to burn coal in a modern installation designed to meet your specific needs.

And with coal you get the added advantage of a future dependability no other fuel can offer. Of all America's fuel reserves, 92% is coal. And to supply this coal, America has the world's most productive coal industry. For economy, for dependability, both now and for the future, you can count on coal!

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!

New equipment and developments

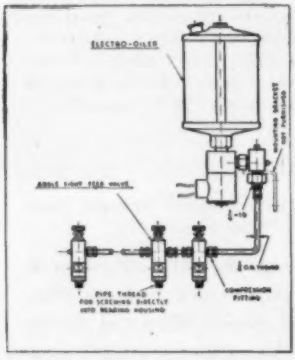
(Continued from page 20)

27—Wax produced in stick form

Solid waxes in stick form for use in metalworking operations are being marketed by S. C. Johnson & Son, Inc. Stik-Wax No. 140 is said to provide a durable clean lubrication for metal sanding and sawing, pipe cutting and threading, drilling, tapping, grinding and flush riveting. The wax is said to extend the life of saws, drills and cutting tools as well as sanding and grinding surfaces. Burrs are eliminated when metal is cut or drilled and a smoother finish is achieved when grinding or sanding. It can be applied manually or set in position to be automatically applied as the machine operates. Each stick of wax measures 2 in. diam and weighs 1 lb.

28—Oiling system is automatic

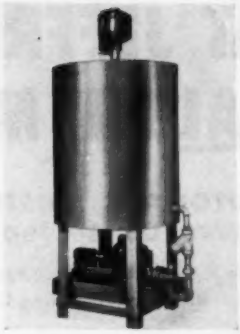
Electro oiling system Style DEI, an automatic single line gravity feed system, is available from Oil-Rite Corp. It consists of a central reservoir with a solenoid operated shut-off valve and a number of individual valves mounted directly into the bearings. Copper tubing connects the reservoir and all valves in series in such a manner that gravity



flow will be maintained. It can be accommodated where space limitation is a problem, and because of its flexibility can be used on innumerable types of installations where points to be lubricated are far apart. Each sight feed valve can be individually regulated. The solenoid valve is usually connected across the line of the driving motor, so that the system will oil the bearings only when the machine is in operation. Reservoirs can be supplied in six sizes, ranging from 4 oz to 1 gal, and in Lucite or glass.

29—Chemical feed unit is self-contained

A packaged chemical feed unit which delivers liquids in desired amounts under pressure has been announced by The Bird Archer Co. It is ideally suited for feeding boiler water treatment as well as delivering chemi-



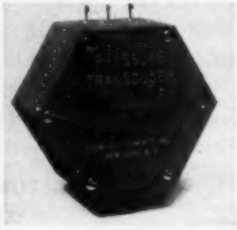
cals and other fluids for processing. This self-contained unit offers high pressure controlled feed at low cost. The chemical proportioning pump can be designed for various rates of feed at different pressures. A motor-driven agitator assures completely mixed fluids at all times. A stainless steel strainer is provided between the suction side of the pump and the tank. The pump is mounted below the tank to minimize air binding and to maintain a positive suction head. A duplex-pump model with divided tank is also available.

TO REQUEST ADDITIONAL FREE DATA

Each paragraph in this section is numbered —beginning with number 1. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out and mail this card. Our Reader Service Department will handle your request promptly

30—Pressure transducers feature versatility

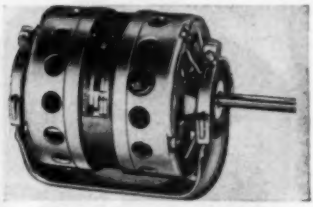
Pressure transducers suitable for air or a wide variety of gases and fluids are announced by Rahm Instruments, Inc. Designated Type PT, they are the bourdon tube actuated potentiometer type. In operation, the physical transient actuates the bourdon



tube, which in turn shifts the position of a brush wiping against a resistance coil. Types are available for measuring pressures from 0-15 to 0-4000 psi gage or differential, and 0-15 to 0-2000 psi absolute. A precious metal alloy is used for the potentiometer winding and brush. The units can be operated under extremes of temperature, humidity, vibration and acceleration, and in atmospheres of dust and corrosive gases. The unit is contained in a hexagonal case measuring 3 in. across the flats. Modifications can be made to adapt any of the units to specific problems involving unusual media such as acids and reducing gases.

31—Fhp motors feature lighter weight

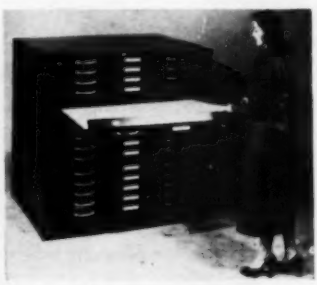
A completely redesigned induction motor, Cyclohm Model 3700, rated 1/25 to ¼ hp, is being produced by Howard Industries, Inc. A resilient mounting base, lightweight and extremely quiet operation are featured. At present, hysteresis syn-



chronous and normal induction types in 2 pole versions, both single and polyphase, are available. Model 3700 motors in 2, 4, 6 and 8 pole models including reluctance synchronous and torque motor types will be available in the near future.

32—File expands with increasing work loads

A versatile engineering drawing file, designed to meet the need of engineering departments everywhere, has been introduced by Diebold, Inc. By the addition of standard modular units containing 5 drawers each, it can be expanded to whatever height required. Standard drawers have a normal capacity of 150 tracings and a maximum filing capacity of 265 tracings. Drawers will handle 48 x 36 in., 36 x 24 in., or 24 x 18 in. drawings. The entire file measures 41½ in. deep and 51 in. wide. The standard 5



drawer section is 15½ in. high, dust proof base units are 4 in. high, and top panel is 1 in. high. Drawers are sliding case-hardened roller bearing type, and all sections are of heavy welded steel.

33—Large capacity collector is portable

A large capacity industrial dust collector which requires only 8 sq ft of floor space, yet is capable of collecting dust from as many as ten grinding wheels, is announced by Aget-Detroit Co. Designed as Model 3050

(Continued on page 32)

Your installations

need

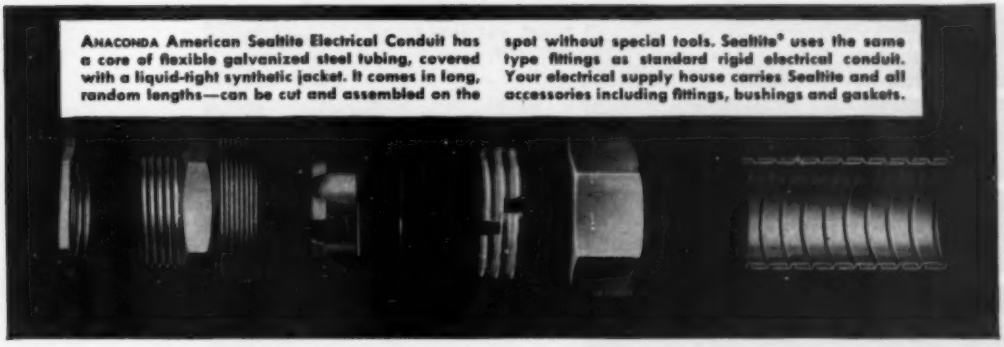
SEALTITE

wherever electrical

wiring needs the

best protection—

American's flexible Liquid-Tight Conduit


ANACONDA American Sealtite Electrical Conduit has a core of flexible galvanized steel tubing, covered with a liquid-tight synthetic jacket. It comes in long, random lengths—can be cut and assembled on the spot without special tools. Sealtite* uses the same type fittings as standard rigid electrical conduit. Your electrical supply house carries Sealtite and all accessories including fittings, bushings and gaskets.

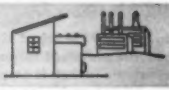
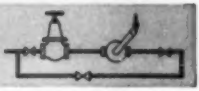
*Trademark

for flexible, liquid-tight electrical conduit—

use SEALTITE AN ANACONDA PRODUCT

THE AMERICAN BRASS COMPANY, AMERICAN METAL HOSE BRANCH, WATERBURY 20, CONNECTICUT. IN CANADA: FAIRBANKS-MORSE COMPANY, LTD.

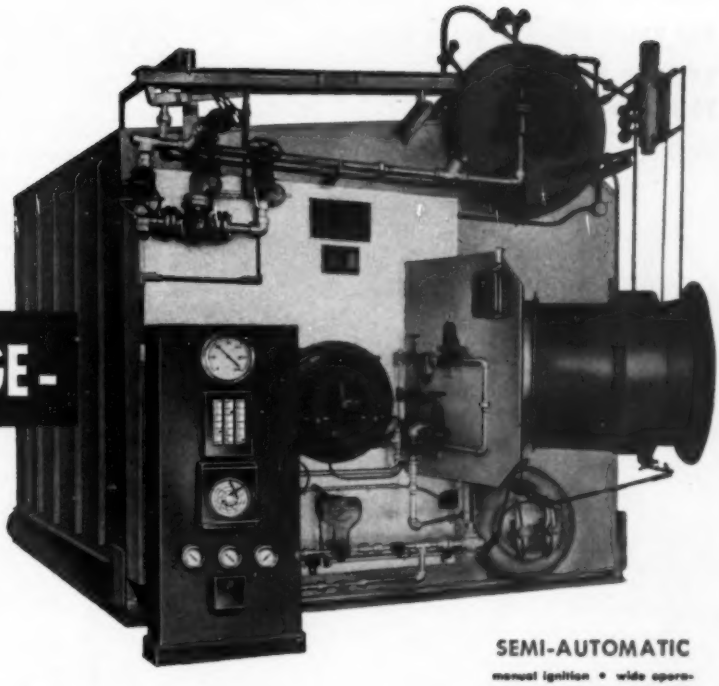
Combined features that distinguish Foster Wheeler package steam generators

WATER TUBE DESIGN	Vertical tubes,...steady water level, closely spaced waterwall tubes on 3½" centers
FACTORY ASSEMBLED STEAM PLANT	Compact, self-contained steam generating units
WIDE RANGE OF CAPACITIES	7,500 to 30,000 lb per hr . . . flexible multi-unit installations for greater capacities
HIGH STEAM TEMPERATURES	Provisions for superheaters in some designs
PORTABILITY	May be transported by common carrier . . . minimizes problems of initial installation and plant relocation
EXPERIENCE	50 years' design, engineering, manufacturing of power plant equipment behind each Foster Wheeler unit
EASILY INSTALLED	Simple foundations . . . few service connections
OUTDOOR INSTALLATION	Rugged, steel encased construction 
ACCESSIBILITY	For inspection,...cleaning, maintenance
COMBUSTION CONTROLS	Fully or semi-automatic controls for single or multi-unit installations
CONTROL VALVES	Equipped with 3-valve by-passes 
CLEAN HEATING SURFACES	Soot blowers incorporated . . . cleaning without boiler shutdown
HEAT LOSS MINIMIZED	Minimum heat loss—from radiation and air infiltration
RAPID LOAD SWINGS	Large diameter drums and ample furnace heating surface

all for the price

FULLY AUTOMATIC

push-button start • operation at all pressures up to design pressure



# of a PACKAGE-

SEMI-AUTOMATIC

manual ignition • wide operating range • modulating control

When faced with the need for a reliable and economic source of steam for your plant, look for these marks of quality and efficiency—water-tube design, generous proportions, electronic controls—notable attributes of the Foster Wheeler Package Steam Generator available in capacities from 10,000 to 30,000 lb of steam per hr. • Write for CATALOG PG-51-2.

FOSTER WHEELER CORPORATION, 165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

SWITCHGEAR DEPENDABILITY BEGINS

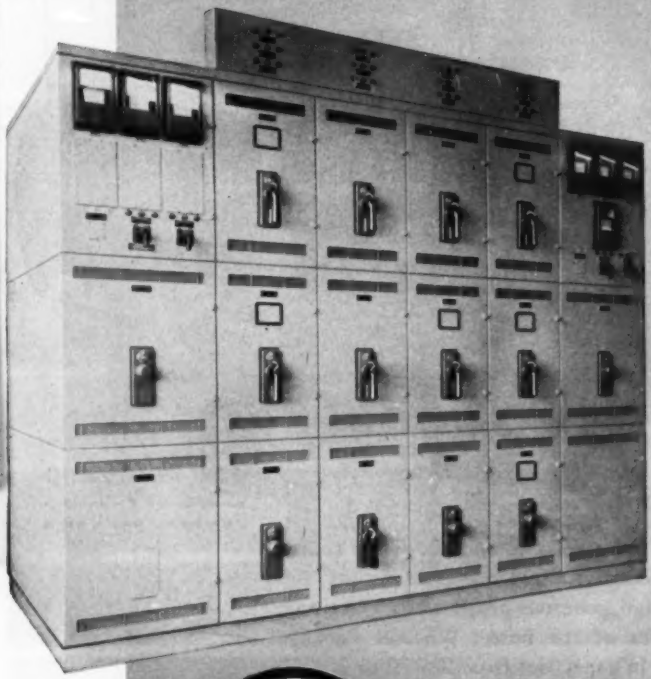
15,000 TO 100,000 AMPERES INTERRUPTING

600 VOLTS A-C, 250 VOLTS D-C

TO 6,000 AMPERES CONTINUOUS A-C OR D-C,
TO 10,000 AMPERES CONTINUOUS D-C ONLY

INDOOR AND OUTDOOR EQUIPMENT

When you buy low-voltage switchgear you buy protection for personnel and equipment. Protection against costly production loss if power should be interrupted by a "nuisance" overload. Protection against the expense of ruined equipment, spoiled processes, and the ravages of fire resulting from a short circuit. Only *circuit breakers* can provide this type of protection!



And to those fully familiar with *difficult* circuit protection problems, *circuit breaker* means *I-T-E*. The history of low-voltage-circuit protection parallels the development of I-T-E circuit breakers.

I-T-E Low-Voltage Switchgear takes advantage of every feature of I-T-E circuit breakers. Thus, it provides users with required protection and safety—along with bonuses of convenience and neat appearance. By specifying I-T-E Low-Voltage Switchgear, you know you have specified the finest circuit breaker.

You can get the complete story on I-T-E Low-Voltage Switchgear by writing for Catalog Section 6004. The I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pennsylvania.

◆ Multumlie "600" Construction for Types KA, KB, KC and LG drawout air circuit breakers—the combination for complete protection of low-voltage lighting, power, and distribution circuits.

I-T-E

LOW-VOLTAGE

I-T-E CIRCUIT BREAKER COMPANY • 19TH AND HAMILTON STREETS • PHILADELPHIA 30, PA.

WITH CIRCUIT BREAKER PROTECTION!

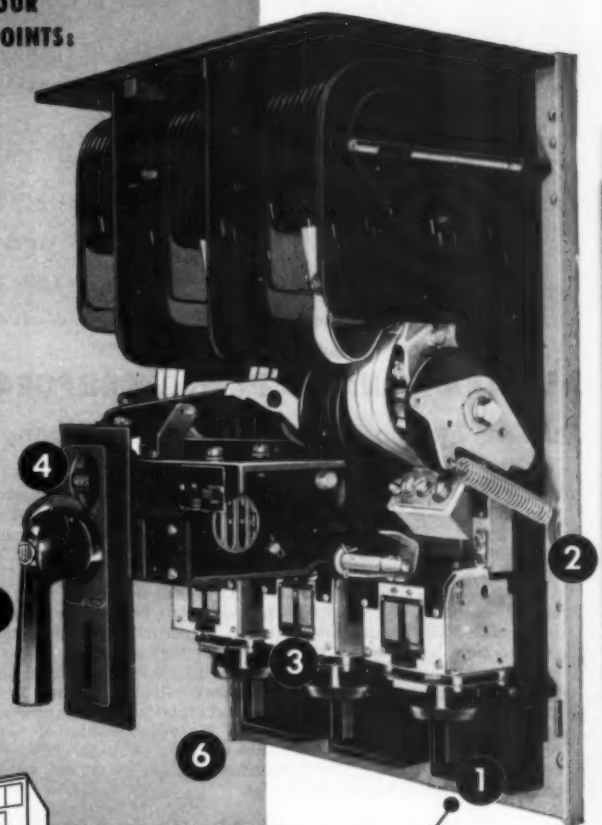
I-T-E "K" LINE CIRCUIT BREAKERS GIVE YOUR SWITCHGEAR THESE PROTECTIVE STRONG POINTS:

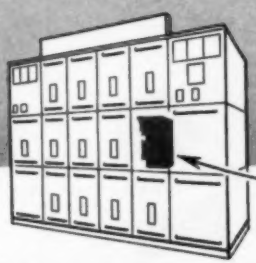
1. Each pole unit is supported in an individual insulating molding. Insulation between adjacent poles is greater than with older, insulated-panel-type breakers.
2. Strong, metal panel provides effective barrier between breaker and bus compartments. Lighter weight allows easier, more convenient breaker handling.
3. Direct acting Inverse-Time-Element overcurrent trip devices are available for every application:

   Dual thermal-magnetic type—for motor starting, running, and short-circuit protection.

   Dual magnetic type—for feeder and short-circuit protection.

   Dual selective type—where coordinated tripping with other protective devices is essential.
4. Position indicator actually protrudes beyond surface of switchgear panel. It is easily visible from any angle.
5. Operating handles are directly connected to breaker mechanism. They are uniform in size, location and appearance in all manually operated breakers.
6. Constructed from unit assemblies, the breakers are easily inspected and maintained. Inventories of small renewal parts are kept to a minimum.



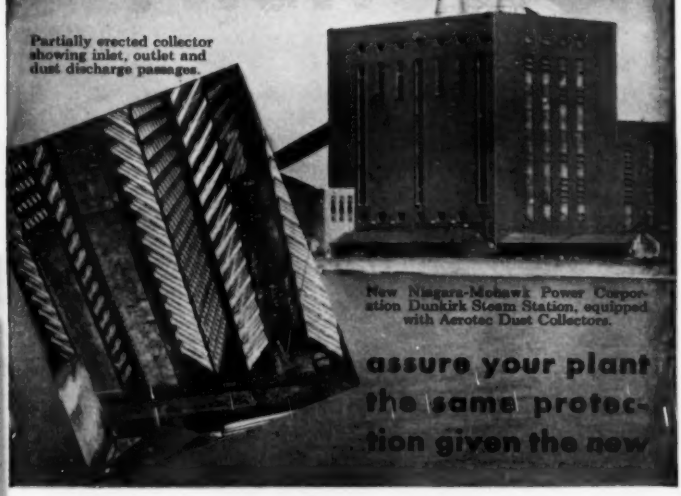


SWITCHGEAR

R&IE Equipment Division: Greensburg, Pa. • Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., New York 17, N.Y.

high efficiency AEROTEC

DUST COLLECTORS



Partially erected collector showing inlet, outlet and dust discharge passages.

New Niagara-Mohawk Power Corporation Dunkirk Steam Station, equipped with Aerotec Dust Collectors.

assure your plant the same protection given the new

NIAGARA MOHAWK POWER CORPORATION

Dunkirk Station . . . and a duplicate Albany Plant

At the new Dunkirk Steam Station of Niagara Mohawk Power Corporation, two reheat steam generators of 670,000 lb. per hour capacity are pulverized fuel-fired. Dust collection for this station is handled by Aerotec, Design 3 RAS Collectors, and a duplicate system is under construction for the new Albany Steam Plant . . . making a total of eleven Niagara Mohawk boilers to be equipped with Aerotec Dust Collectors.

The collectors for Dunkirk and Albany consist of 84 "Unit Building Block" elements completely assembled at the factory for easy erection in the field. The small diameter tubes, of permanent molded aluminum construction, have proved their extremely high collection efficiency and long life on hundreds of installations. Their light weight cuts steel requirements for supporting structure, and makes possible roof installations with a minimum of reinforcement. The light weight tubes also reduce erection costs.

Aerotec efficiencies meet or exceed the requirements of most dust ordinances today. Evenly spaced tube outlets provide excellent inlet flow conditions for an AEROTEC electrical secondary—should future ordinances require still higher efficiencies.

Write for the new Design 3 RAS Catalog No. 601.

Project and Sales Engineers

THE THERMIX CORPORATION

GREENWICH, CONNECTICUT

(Offices in 38 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD.
8440 St. Catherine St., W., Montreal 25, Quebec • 50 Abell St., Toronto 3, Ontario

THE AEROTEC CORPORATION

GREENWICH, CONNECTICUT

Manufacturers of mechanical dust collectors, electrical precipitators, air cleaners, industrial integral dust collectors, gas-oil scrubbers and dust reclaiming equipment.

New equipment and developments

(Continued from page 28)

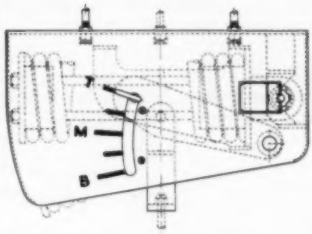
Dustkop, it has a rated capacity of 3630 cu ft of air per min at 6 in. static suction measured in an 8 in. inlet pipe. Air is drawn into the unit by a self-clearing paddle wheel fan driven by a 5 hp, 220 or 440 v, 3 phase, 60 c motor. The first stage cleaner is a cyclone separator. The second stage cleaning is by a compressed Fiberglas filter which cleans the air and returns it to the working space for saving of heat. Installation requires only connecting to electrical power and the piping system. No out-of-doors connections are required. Being entirely self-contained, the unit is portable. Floor size of the unit is 29 x 50 in., and over-all height is 11 ft. The small space requirements make it possible to place the unit close to the dust-creating equipment.

TO REQUEST ADDITIONAL FREE DATA

Each paragraph in this section is numbered —beginning with number 1. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out and mail this card. Our Reader Service Department will handle your request promptly

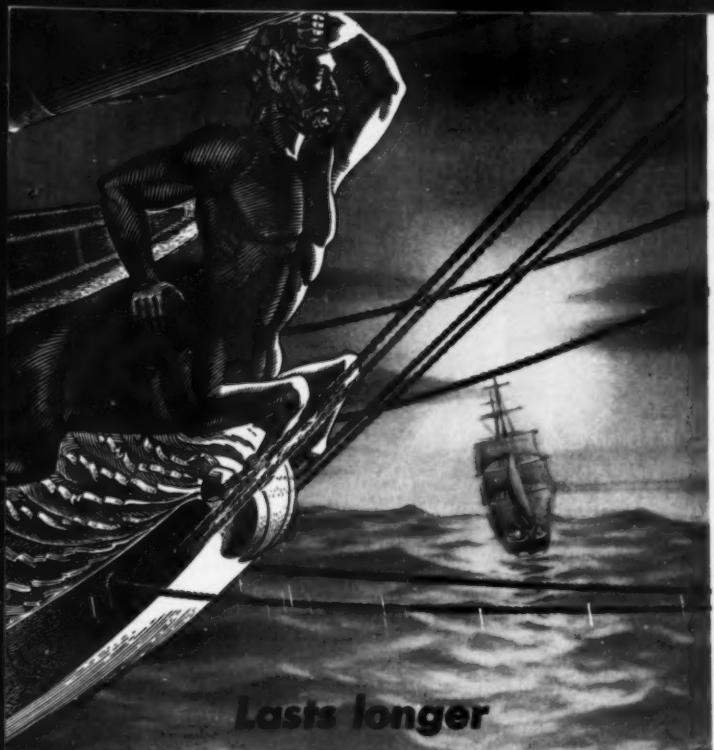
34—*Hanger incorporates many desirable features*

Many features to alleviate installation and operational problems are incorporated in a constant support pipe hanger manufactured by Bergen Pipesupport Corp. Normal longitudinal as well as transverse movement is permitted without impairing efficiency. A minimum number of moving parts is incor-



porated. Only one compression spring is used, and a compensating device is not needed. Permanently lubricated needle bearings and self-oiling bushings minimize friction, giving smooth stable operation. Travel is indicated by a large pointer that has a full swing of approximately 7 in., irrespective of total travel. Initial setting and periodic checking is therefore simplified. The hanger is available in 25 sizes ranging in travel from 2 to 12 in., and in a load capacity from 50 to 8380 lb. Units can be coupled or placed in multiples for increased capacity.

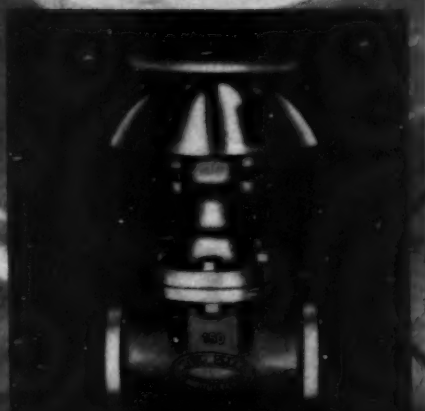
(Continued on page 34)



Lasts longer in corrosive service

Like all ALOYCO valves, this acid-shield gate valve is especially engineered for severe corrosive service. Its dependable performance results from extensive metallurgical research and production of high alloy valves exclusively.

ALOYCO No. 111-A [illegible] gate valve is made in a wide range of analyses to [illegible] and regularly stocked in popular alloys.



SUCCESS STORIES FROM ALOYCO'S CORROSION CLINIC

THE CORROSIVE: Water contaminated with 20% acetic acid.

THE APPLICATION: Step in manufacture of aspirin powder for The Bayer Company, division of Sterling Drug, Inc.

THE VALVE: ALOYCO No. 111-A Gate valves.

THE RESULTS: Corrosion and subsequent leakage required replacement of cast iron valves. Sixteen ALOYCO gate valves have been in service two and a half years completely free of maintenance.

THE BACKGROUND: Contamination prevention is only one reason why ALOYCO valves are selected for such a wide variety of applications in the chemical industry.

The *Aloyco Corrosion Clinic* works exclusively in corrosion-resistant alloys. Your problem—whether it is contamination, discoloration, temperature extremes, corrosion, or cost—can be solved by the Clinic.

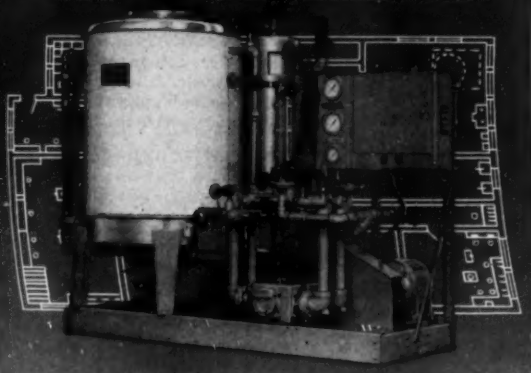
If you must guard against corrosion, call on the *Aloyco Corrosion Clinic*, for the right alloy, the right valve.

The Bayer Company is so completely satisfied with the performance of ALOYCO valves in this installation they are buying more for all parts of the plant.

ALLOY STEEL PRODUCTS CO., INC.
1305 West Elizabeth Avenue, Linden, N. J.

Longer Lasting
ALOYCO VALVES
1st in Corrosive Service

MORE STEAM
Faster and at Less Cost



SPECIFY *Clayton*
FORCED RECIRCULATION
STEAM GENERATORS

Plan your steam plant for long range economy and realize immediate savings on installation and operating costs.

The Clayton *Forced Recirculation* Steam Generator...in sizes from 15 to 100 h.p., and equipped to burn gas or oil, or both...is a compact, self-contained steam plant ready to install and operate as it is delivered. No accessories to buy. No stack, bricking or foundations to install. Move into place; connect fuel and water lines, electricity and vent, and the Clayton generator is ready to operate. Occupies 30% to 70% less space than conventional boilers of same capacity.

Within 5 minutes from a cold start, the Clayton generator attains full operating pressure. Any fluctuating load demand within its rated capacity is instantly and automatically met. No standby losses. High thermal efficiency cuts fuel costs in half, or better. On gas fired units, new electronic safety control proves the flame pilot; automatically shuts down plant on ignition failure or loss of fire. Clayton generators are built to conform to the A.S.M.E. Boiler Code, and are Hartford inspected. Send the coupon for complete catalog.

The coupon below brings a convincing demonstration to your desk.

STEAM PLANT OPERATORS *Mail this coupon*

CLAYTON MANUFACTURING COMPANY IP-4
Box 550, EL MONTE, CALIFORNIA

Send name of nearest distributor and arrange desk demonstration of Clayton *Forced Recirculation* principle. Send catalog.

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

Animated flow chart shows how *Forced Recirculation* principle cuts steam costs.

New equipment and developments

(Continued from page 32)

35—*Steam-jet cleaner is designed for heavy duty*

A portable electric steam-jet cleaner designed for heavy duty industrial requirements has been announced by Livingstone Engineering Co. Operating on the steam-detergent principle, this unit, the Speedylectric Model JC-50, supplies dry steam to 200 psig and rinse water to 400 psig. A built-in boiler, Underwriters' Laboratories listed and ASME Code, provides steam for cleaning and rinse water heating. Complete freedom from fire hazards is featured, as well as no low water hazard or coils to burn out, and no dangerous fuel tanks. The unit requires power availability of not less than 30 kw; 220, 440 or 550 v; 3 phase; and water supply of 250 to 300 gph.

TO REQUEST ADDITIONAL FREE DATA

Each paragraph in this section is numbered —beginning with number 1. This is the "key" number which should be inserted on the return post card on page 131. Just fill in, tear out and mail this card. Our Reader Service Department will handle your request promptly

36—*Instrument pen eliminates flooding*

Industrial instrument pens that eliminate flooding and reduce paper plugging and choking have been designed by Brown Instruments Div. of Minneapolis-Honeywell Regulator Co. for their strip chart electronic

instruments. They have removable tips and a reservoir construction which eliminates flooding because effective ink level is always below the writing tip. Decreased pressure on the chart tends to reduce fibre choking. Thorough cleaning is made easy by a simple disassembly. The pens, designed to fit standard pen carriages, can also be adapted to existing instruments.

End

B.F.Goodrich GROMMET BELTS AT WORK

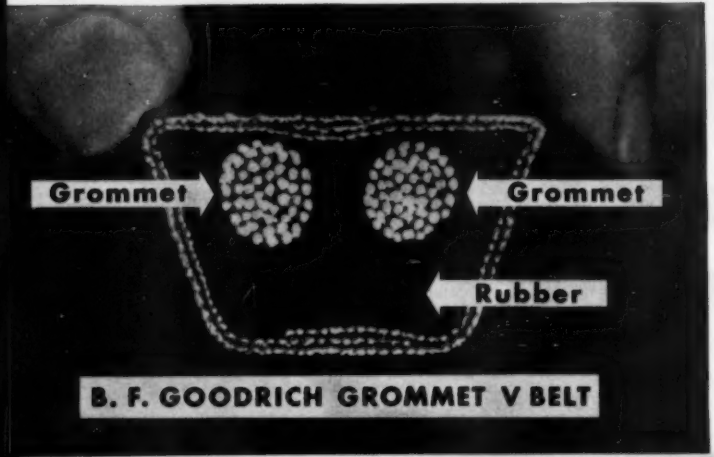
Mechanical railroad "detective" with X-ray eyes that can "see" right through steel helps prevent train accidents.

"Track walker" sees through steel

That car inspects more railroad track in a day than a man on foot could cover in a week. Delicate electrical equipment detects hidden flaws a man could never see. Two big generators supply the electricity, but the belts needed to run them caused trouble. Stretch or slip of the belts affected the generators, and that distorted the testing equipment. Ordinary V belts stretched badly; replacement was frequent and costly. On the next page you'll see how an entirely different kind of belt solved the problem.

Track walker (continued)

Belts that slipped and stretched set off a chain reaction that spoiled the vision of X-ray eyes in the Sperry Detector Car.



THE problem described on the preceding page was solved when B. F. Goodrich grommet V belts were installed. Grommet belts are more flexible, don't slip or stretch as much as ordinary belts. Now BFG grommet belts are giving 3 times the service of other belts, saving belt costs, and cutting repair and maintenance time by 60 per cent. Here's the reason grommet belts last longer, serve better, save money.

20 to 50% Longer Life

Patented grommet V belts by B. F. Goodrich represent the only basic improvement since invention of the V belt. Belts last 20 to 50% longer, depending on service. (The more severe

the service the greater the increase over ordinary belts.)

What is a grommet?

A grommet is like a giant cable except that it's endless—a cord loop built up by winding heavy cord on itself. There is no overlapping cord *section* as in all ordinary belts. Most belt failures occur in these sections where cords overlap!

All Cords Put to Work

Each grommet and every part of a grommet carries its share of the load. In ordinary belts under high tension the center cords "dish" because tension is greater near the driving faces. Dished cords are doing less work, not pulling their share. Grommet V belts have no center cords, there is no dishing—therefore much more strength in proportion to cord volume.

Better Grip, Less Slip

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give ⅓ more gripping power, pull heavier loads with a higher safety factor.

They Cost No More

You save belt costs because belts last longer, reduce production costs because machines keep running with fewer interruptions, reduce maintenance costs because they need less attention, yet cost not one cent more than others. Grommet belts are made in C, D and E sections. They are patented by B. F. Goodrich. No other V belt is a grommet belt (U. S. Patent Number 2,233,294).

Highway robber

When this drive stops, rock needed for highway construction doesn't get crushed, new roads don't get built on schedule. In addition to running 9 hours a day, 6 days a week, the belts that drive the rock crusher are exposed to dampness, oil and sharp grit. Previous belts suffered from shock loads, wore out fast. The company, Valley Limestone & Gravel, Inc., Farmington, Iowa, tried other V belts, even flat belts, but mechanical trouble and production hold-ups continued. Then a B. F. Goodrich man suggested grommet V belts to stand the jerks and hard pulls. The B. F. Goodrich grommet V belts shown here have been in service 2 years, production has been increased 25%, labor and maintenance time has been reduced.

Jolting, crunching action of rock crusher used to cause production "hold-ups".

B.F.Goodrich GROMMET BELTS AT WORK

Softened up for a beating

It's wash day round-the-clock, 6 days a week in this plant. Here rags are soaked and shredded before being beaten to a pulp and used for making paper. Belts are used to drive the washer, but it's rough service. Starting it causes shock loads, and the long hours would be a strain on any driving mechanism. Something exceptional was needed, so B. F. Goodrich grommet V belts were installed. They have done a better job of running the machine than belts previously used, and stood the shock and strain for 8½ years.

Every day is wash day at Millers Falls Paper Company, Millers Falls, Mass.

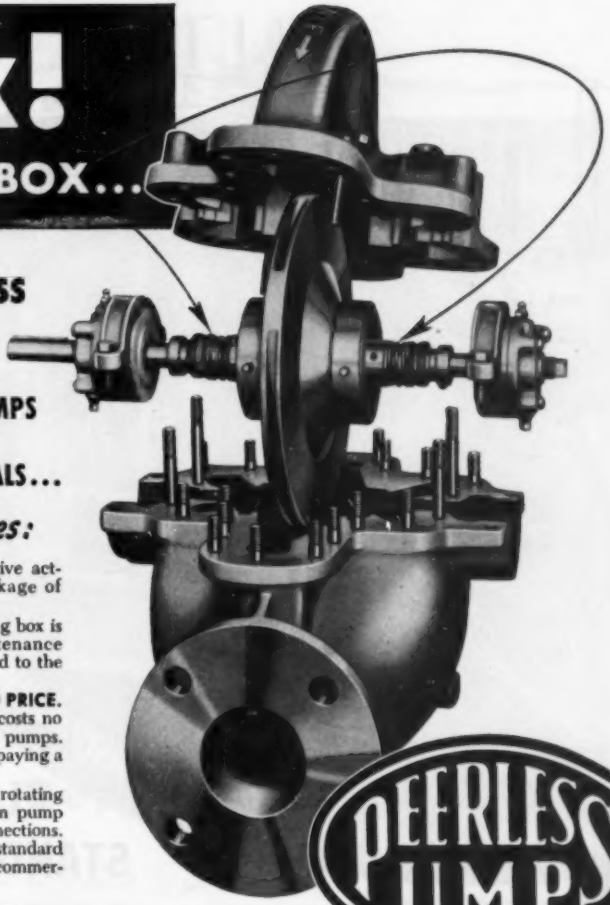
These typical examples (see preceding pages) tell you why B. F. Goodrich grommet belts are superior to ordinary V belts — prove they last 20 to 50% longer—yet cost no more.

Grommet V Belts BY
B.F.Goodrich
FIRST IN RUBBER

The B. F. Goodrich Company, Industrial Products Division, Akron, Ohio

LOOK!

NO STUFFING BOX...



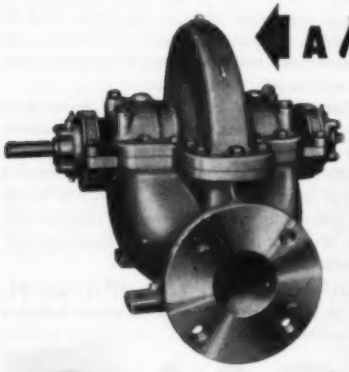
THE NEW PEERLESS TYPE AS

GENERAL PURPOSE PUMPS are designed around MECHANICAL SHAFT SEALS...

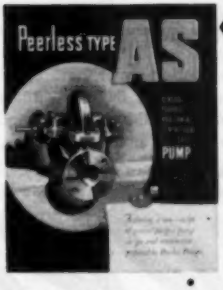
Here are 4 Big Advantages:

1) **NO LEAKAGE.** Simple, positive acting, shaft seals prevent leakage of liquid from pump.
2) **LESS MAINTENANCE.** Stuffing box is completely eliminated; maintenance trouble and expense is reduced to the minimum.
3) **CUSTOM PUMP–*STANDARD* PRICE.** The Peerless Type AS pump costs no more than ordinary split-case pumps. You get extra quality without paying a premium.
4) **EASILY SERVICED.** Entire rotating element can be removed from pump without disturbing line connections. Shaft seals and bearings are standard items, easily available from commercial sources.

PEERLESS PUMPS



A *NEW* PUMP
A *NEW* BULLETIN



Write for Bulletin No. B-1350 which completely describes and illustrates the modern design and construction features of Peerless Type AS pumps.

PEERLESS PUMPS fmc

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
Address inquiries to Factories at:
Los Angeles 31, Calif. and Indianapolis 8, Indiana
Offices: New York, Chicago, St. Louis, Atlanta; Dallas, Plainview and Lubbock, Texas; Fresno; Los Angeles; Phoenix; Albuquerque, N. M., Tulsa.

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, California

Please send us a copy of Bulletin No. B-1350 describing Peerless Type AS pumps.

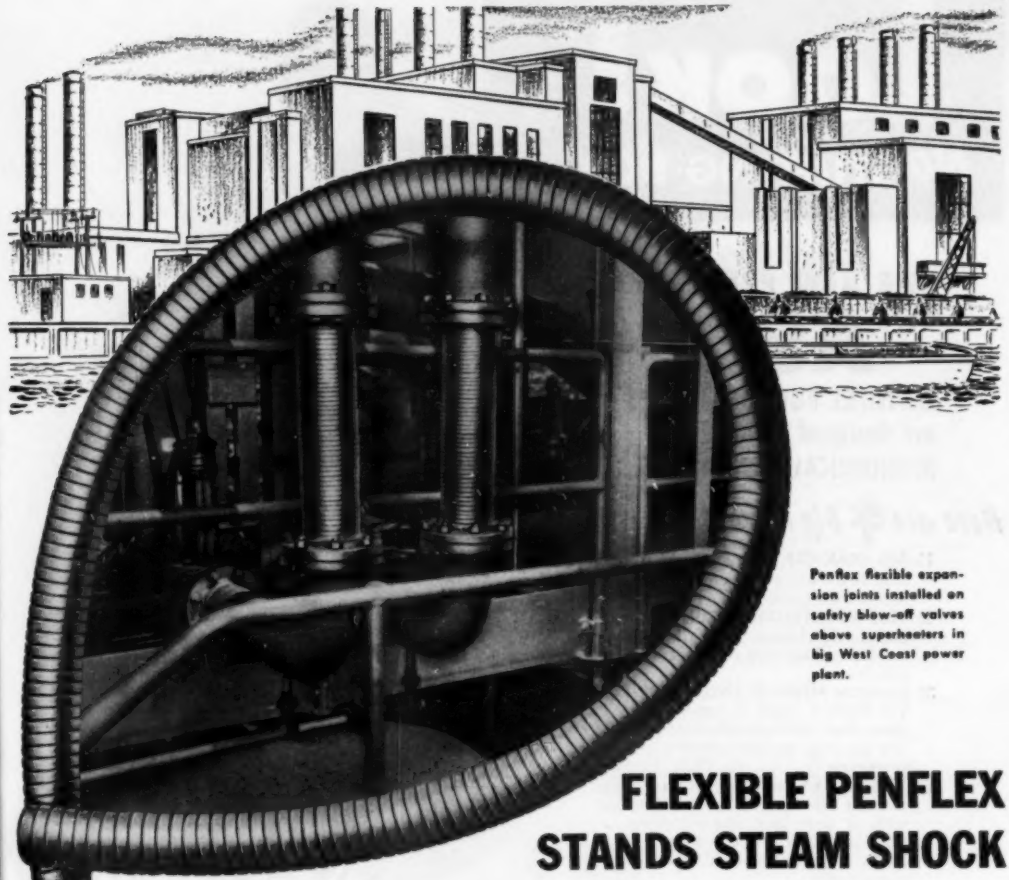
NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

SPI I&P



Penflex flexible expansion joints installed on safety blow-off valves above superheaters in big West Coast power plant.

FLEXIBLE PENFLEX STANDS STEAM SHOCK

PENFLEX TUBING ABSORBS THERMAL EXPANSION . . . PREVENTS BLOW-OUT

Without warning, the safety valves atop these big superheaters suddenly pop. A mighty surge of 900 F, eight-hundred-and-fifty-pound steam blasts through the pipes to exhaust to atmosphere. These pipes have to know how to take it!

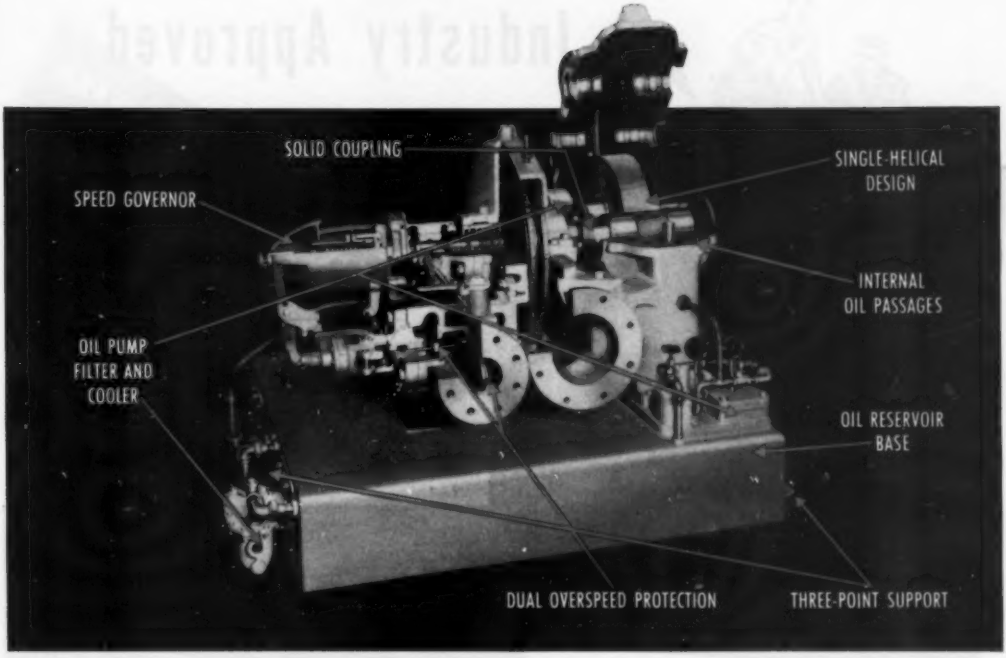
Ordinary rigid pipe would blow apart under the terrific thermal expansion. But Penflex flexible metal tubing has enough "give" to take the shock. Six lengths of 8" Penflex interlocked tubing installed as expansion joints on the boiler blow-off line cushion the sudden impact . . . take up any pipe movement due to extreme temperature and pressure changes.

Penflex engineers can help you solve your tough tubing problems. Penflex makes a complete line of 4-wall interlocked and seamless welded corrugated tubing . . . metallic hose, tubing and couplings from ⅛" I.D. up . . . automatic barrel fillers, pneumatic rivet passers, accessories and fittings. Write for illustrated folder "Flexineering." It's a valuable production aid.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7238 Powers Lane, Phila. 42, Pa.
Branch Sales Offices: **Boston • New York • Chicago • Houston • Cleveland • Los Angeles**

penflex

HEART OF INDUSTRY'S LIFE LINES



TYPE E Gearturbines

Cost Less to Buy . . . Less to Operate

Here's the ideal steam drive for ratings up to 500 hp and output speeds commonly found in single-ended applications such as pumps, fans, compressors, line shafts and generators. It's the Westinghouse Gearturbine that saves you money right from the start. You save on its purchase . . . you save on operating costs.

Save on purchase price because the Westinghouse Gearturbine comes as a complete package. It costs much less than buying a turbine and a separate speed reducer . . . costs less to install, too!

Save on operating costs because every turbine part has been built to give long life and dependable service. An anti-corrosion treatment on vital parts reduces wear and maintenance . . . and there's dual protection against overspeed.

You get these additional features:

Solid coupling of turbine shaft to pinion shaft, makes it easy to align pinion bearings with turbine bearing.

Single-helical gearing; endwise movement of one shaft will not affect axial location of the other. Running clearances are maintained.

Internal oil passages avert accidental damage, improve appearance.

Forced circulation of filtered oil assures thorough lubrication of gears and bearings.

3-point support for maximum ease in leveling and aligning.

Unique oil reservoir forms sturdy base for unit . . . simplifies mounting and installation.

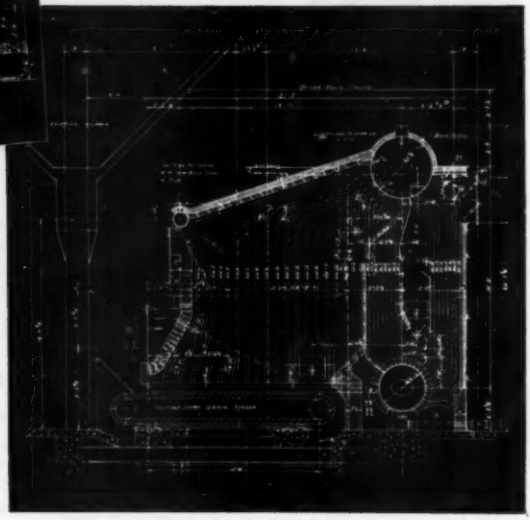
Type E Gearturbines are available in any combination of three wheel sizes, three gears and three types of governor. Your nearby Westinghouse representative has all the facts. Ask him for Booklet B-4346, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50524

YOU CAN BE SURE . . . IF IT'S
Westinghouse
TYPE E
Gearturbines

Industry Approved

Two-Drum STEAM GENERATORS by Vogt

CLASS VF
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



CLASS VS
The Seelbach Hotel, Louisville, Ky. is served by this 30,000 pounds steam per hour boiler.

A wide variety of industrial plants and other users of steam for power, processing, or heating have found these efficient Vogt Two-Drum Type Boilers to be the answer to their diverse steam generating requirements.

Class VF units provide maximum capacity in limited floor space and head room, while Class VS is best adapted to installations not having such restrictions. Each has a large furnace volume and a high ratio of radiant heating surface. The furnace design assures proper combustion of fuels fired in suspension or with various type of stokers.

A bulletin with general information and showing typical installations is available on request.

Typical Users...

FOOD PROCESSING PLANTS
DISTILLERIES • HOTELS
HOSPITALS • CHEMICAL PLANTS
PETROLEUM REFINERIES

HENRY VOGT MACHINE CO., Louisville 10, Kentucky
BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

Boiler scale is a deposit formed from solution directly in place upon a confining surface. It is crystalline and dense and usually retains its physical shape when removed. (Ref. ASTM D 887, D 933).

Use DREW POWER CHEMICALS

No boiler is exempt from scale under present day operating conditions. Scale results in tube failure, plant shut-down, trouble and inconvenience. It's the duty of every good water treatment company to recognize and solve this problem.

Draw a bead on boiler scale! Call in the Drew Engineer. The water samples and operating data that he obtains in your plant will be thoroughly analyzed in the Drew Laboratories, and you'll be given specific recommendations for corrective or preventive treatment. And you'll receive frequent and continous service, too.

Thorough investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Consult the nearest Drew engineer or write for information.

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS

Nationwide Service in Boiler Water and Cooling Water Conditioning

DREW PRODUCTS

"S" MONEL

A casting alloy offering extra hardness at elevated temperatures, pronounced resistance to galling and seizing, and excellent corrosion resistance.

One of the hardest and strongest of the non-ferrous casting alloys, "S"® Monel is particularly suitable for parts subject to high stress and severe friction under corrosive conditions.

"S" Monel's low coefficient of expansion, high density and corrosion resistance enable it to give excellent service where clearances are small and operating temperatures subject to considerable variation.

The principal characteristics of "S" Monel are:

• • •

Typical Applications of "S" Monel

valve discs	bushings
valve seats	sleeves
impellers	ejector nozzles
wear rings	direct-acting pump liners

Mechanical Properties of "S" Monel*

(Age-hardened)

Yield Point	80-115,000 psi
Tensile Strength	120-145,000 psi
Elongation in 2-in.	4-1%
Hardness (Brinell)	300-375
Coefficient of Thermal Expansion (32°-212°F.) in./in/°F.	.0000068

Hardness of "S" Monel at Elevated Temperatures*

(As-cast condition)

Temperature, °F.	Brinell Hardness
Room	321
700	321
800	311
900	311
1000	321
1050	335
1100	293

**Average properties—not to be used for specification.*

Hardness: "S" Monel can be age-hardened to 300-375 Brinell. It retains this hardness even at elevated temperatures. (See table.)

Resistance to Galling: "S" Monel is superior to most other hard metals in its ability to resist galling under severe conditions of pressure and friction. Often where lubrication is poor or absent entirely, "S" Monel has shown unusual resistance to seizing.

Corrosion Resistance: "S" Monel is relatively unaffected by most commonly-encountered corrosives . . . reducing acids, organic acids, acid and neutral salt solutions, strong alkalies, dry gases, and most atmospheres.

Erosion Resistance: Because of high hardness and toughness, "S" Monel resists damage caused by cavitation, erosion, "wire drawing," and particle abrasion.

Machinability: "S" Monel can be machined as-cast, and preferably so when only a moderate amount of machining is to be done. For extensive machining, the castings may be softened to 235 Brinell by heat treatment. Subsequent heat treatments can restore hardness to the level of 300-375 Brinell.

Weldability: "S" Monel is *not* recommended as a weldable material.

Additional Engineering Data Available

Although nickel alloys are currently in short supply, they won't always be. So why not let INCO *help you in your long-range planning—particularly if your plans involve a choice of corrosion-resisting materials? A letter outlining your problems brings technical assistance, helpful data. Write* INCO'S *Technical Service Station.*

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE
NICKEL INCO ALLOYS

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL
NICKEL • LOW CARBON NICKEL • DURANICKEL®
INCONEL® • INCONEL "X"®

Air Casualties

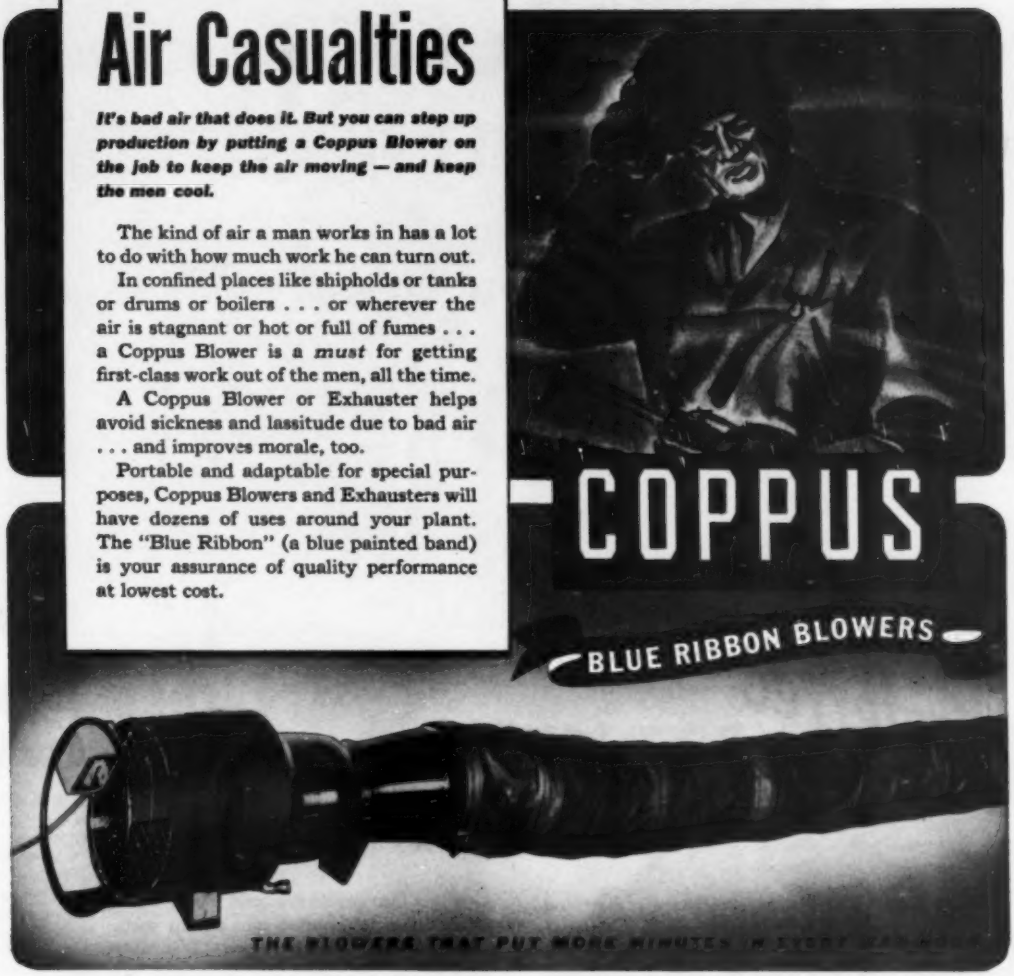
It's bad air that does it. But you can step up production by putting a Coppus Blower on the job to keep the air moving — and keep the men cool.

The kind of air a man works in has a lot to do with how much work he can turn out.

In confined places like shipholds or tanks or drums or boilers . . . or wherever the air is stagnant or hot or full of fumes . . . a Coppus Blower is a *must* for getting first-class work out of the men, all the time.

A Coppus Blower or Exhauster helps avoid sickness and lassitude due to bad air . . . and improves morale, too.

Portable and adaptable for special purposes, Coppus Blowers and Exhausters will have dozens of uses around your plant. The "Blue Ribbon" (a blue painted band) is your assurance of quality performance at lowest cost.



CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS . . . DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU

MAIL THIS COUPON To Coppus Engineering Corp., 184 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fuselages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets, etc., after treated with coating material.

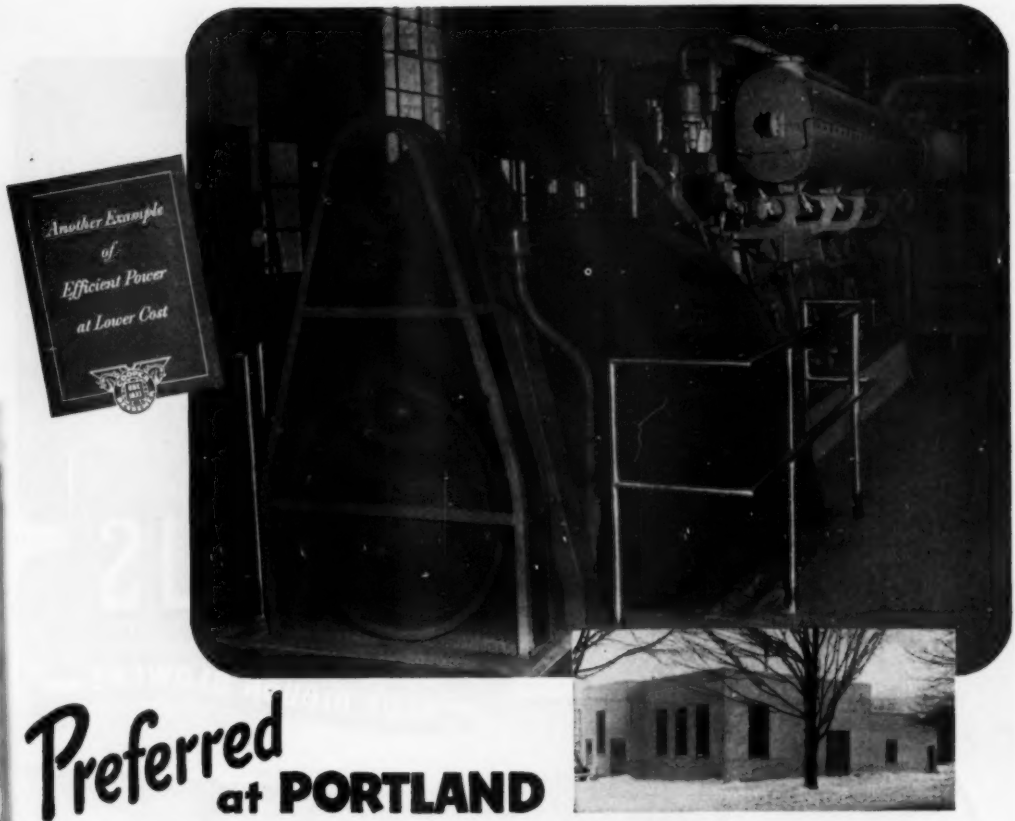
NAME .....

COMPANY .....

ADDRESS .....

CITY .....

(Write here any special ventilating problem you may have.)



Preferred at PORTLAND

. . . Cooper-Bessemer fuel and space savings!

POWER facilities at the Village of Portland, Michigan, had to be expanded. A Cooper-Bessemer diesel was the carefully considered choice — as is so often the case in municipal, R.E.A. and other stationary services when *all* the facts are weighed.

Portland's new Cooper-Bessemer is shown above — a modern, supercharged JS-8, rated 1,158 bhp at 450 rpm driving an 820 K.W. generator

First, for an engine that has proved itself equal to year after year of continuous, trouble-free service, it offers unmatched *compactness* — a fact that saved Portland plenty in reduced installation, foundation and piping costs.

Second, the supercharged JS is noted for exceptional efficiency and unusually low fuel consumption at all loads.

If your plans call for diesel, gas-diesel or gas engine power, 60 to 3700 hp, be sure to get information on the Cooper-Bessemer developments that can save you money all along the line.

The
Cooper-Bessemer
Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

Starts fast at forty below...

This belt conveyor carries coal from railroad cars to overhead hoppers for a power company located in the northern part of the Midwest . . . so far north that temperatures frequently hit forty below zero. Starting the conveyor in that kind of weather meant lost time, wasted manpower. The bearing lubricant became so stiff that five or six men often were required to pull on the belt. Three hours a day frequently were lost in getting the unit in operation.

As many as a dozen conventional lubricants were tried without success before a change to STANOLITH Grease No. 42 was made on the recommendation of a Standard Oil lubrication specialist. None could match the ability of STANOLITH to provide easy starting at extreme low temperatures, and still maintain effective lubrication during high summer temperatures.

STANOLITH Greases are filling the bill in a wide range of industrial and processing applications because of their resistance to heat and to the washing action of water, and their ability to flow readily under wide variations in temperature. A Standard Oil lubrication specialist can help you take advantage of these special properties. A call to your local Standard Oil Company office is all that's necessary. Or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANOLITH
TRADE MARK
Greases

What's your problem?

Meet R. R. Rowlands, of Standard's La Crosse office. He is the lubrication specialist who worked with this power company to find the right grease for an especially tough job. And as a result of his work, the company was able to save considerable time in the operation of a coal conveyor.

His on-the-job service is typical of that available to all midwest plants through a corps of such lubrication specialists. You can be sure that the specialist in your own area has both the practical experience and the training in a Standard Oil Lubrication Engineering School that will result in dependable, thorough assistance.

Why not call your local Standard Oil Company office today? Put a lubrication specialist to work on your problem now. When he calls, be sure to discuss the advantages and performance records of these outstanding products:

STANOIL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in air compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

CALUMET Viscous Lubricants—These greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of open gears and chains, better internal lubrication of wire ropes.

STANDARD OIL COMPANY **STANDARD** (*Indiana*)

Works without Attention to Furnish Clean Water —Cheap

This is the way many industrial plants solved the problem of high water bills and low water supplies.

They use Cuno FLO-KLEAN Strainers to remove trash from raw water . . . or to reclaim used process water.

Some users have saved enough to pay for their FLO-KLEANS in a few months!

The FLO-KLEAN is a large-capacity (up to 20,000 gpm), corrosion- and abrasion-resistant strainer which positively removes all solids larger than specified.*

Continuously Self-Cleaning

Operation is continuous—with never a stop for cleaning the FLO-KLEAN. This eliminates the need for a duplex installation.

Self-cleaning is accomplished by an automatic backwash system which makes a further saving of water by recycling the backwash.

So—with continuous cleaning of the cartridge and automatic top and bottom blow-down, there's nothing to worry about. FLO-KLEAN can be installed in some remote place and forgotten.

*May be specified from .030 in. down to .0025 in.

Cuno Engineering Corporation
Dept. 142F, South Vine Street, Meriden, Conn.

Please send information on Cuno FLO-KLEAN for straining raw water..... reclaiming process water....

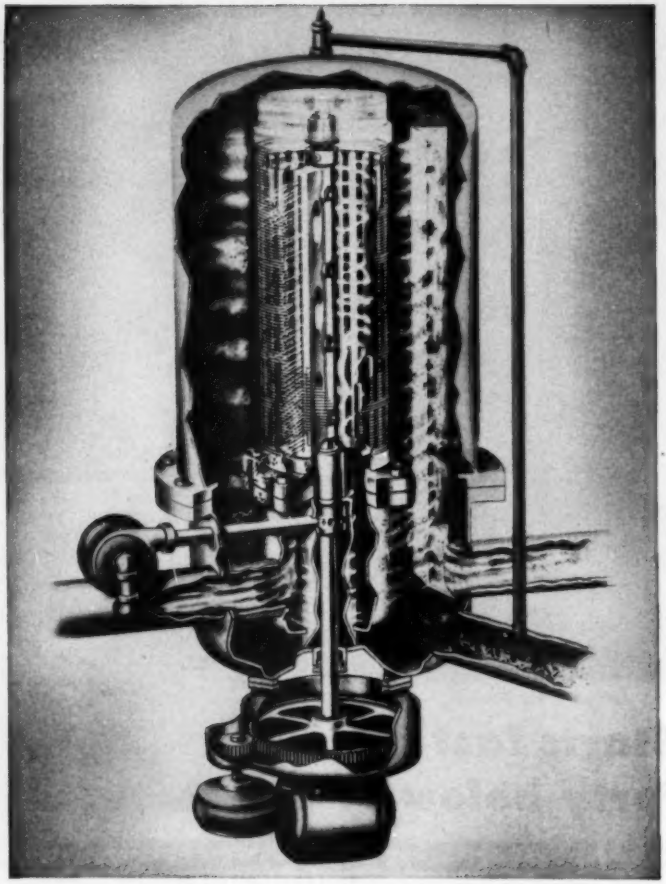
Name..... Title.....

Company.....

Address.....

City.....Zone....State.....

Please attach to business letterhead



How many times do you re-use your water?

Cut water *waste* and water *bills*. Make used process water fit for re-use by running it through a Cuno FLO-KLEAN strainer. Also—a low-cost way to clean raw river or lake water for industrial use.

CUNO

Fluid Conditioning

Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

SAW CONCRETE ....

OR ASPHALT

with CLIPPER CONCRETE SAWS

THIS FAST-EASY ECONOMICAL WAY!

NOW SAW . . . BEFORE BREAKING! On patches and trenches the removal costs are reduced more than 25% and replacement material is poured to straight, smooth edges. A sawed cut made ¼ the slab depth provides a perfect plane of weakness for fast breaking and removal.

Patches...

Eliminate spalling and fractures around repair patches by sawing before breaking. Saw clean, straight lines, break smooth, then patch perfectly in building floors, runways, drives, etc.

Trenches...

Gas, Water, Electric, Sewer, Telephone . . . wherever new lines are installed or old ones repaired. Saw trenches . . . any width . . . then break out to straight, smooth edges — no fractures beyond removal lines.

Contraction Joints...

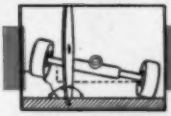
Saw contraction joints in continuously poured slabs and eliminate costly hand forming and usual spalling. Building floors, highways, streets, runways, walks, etc. can all be sawed.

MODEL C-130
One of FIVE MODELS
Gas or Electric Power

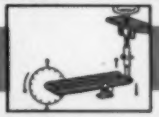
Free Trial...

You can TEST—actually TRY a Clipper Concrete Saw on YOUR Job without obligation! Write for details! . . by the Originators of Masonry Saws.

MAXIMUM ECONOMY IN CONCRETE CUTTING
ONLY POSSIBLE WITH THESE EXCLUSIVE CLIPPER FEATURES



1. Clipper "No Bind" Floating Three Point Suspension Automatically protects blade



2. Positive Screw Feed Instant control raises or lowers blade smooth, easy

3. Adjustable Depth Lock Set this handy stop for whatever depth desired.

4. Patented Spray Control Its value is measured in increased Blade Life.

Clipper

KANSAS CITY 8, MISSOURI

PITTSBURGH
ST. LOUIS
CLEVELAND
INDIANAPOLIS
DETROIT
HOUSTON
AUSTIN, TEX.
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LOS ANGELES
PHILADELPHIA
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ATLANTA
WASHINGTON, D. C.
BOSTON
BIRMINGHAM
KANSAS CITY

"COAST-TO-COAST"

GENUINE CLIPPER BLADES ALL DIAMETERS

DRY-WET & R-R BLADES

DIAMOND BLADES

MAIL THE COUPON TODAY!

Serving the World as the World's Largest Manufacturer of Masonry Saws

CLIPPER MANUFACTURING CO.
CONCRETE SAW DIVISION
13 E. 28th ST., KANSAS CITY 8, MO.
Send FREE Literature, Information and Prices on the NEW CLIPPER CONCRETE SAWS 7-C

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COMPANY _____

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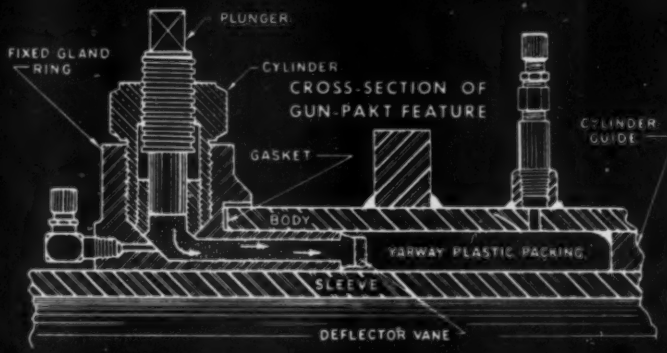
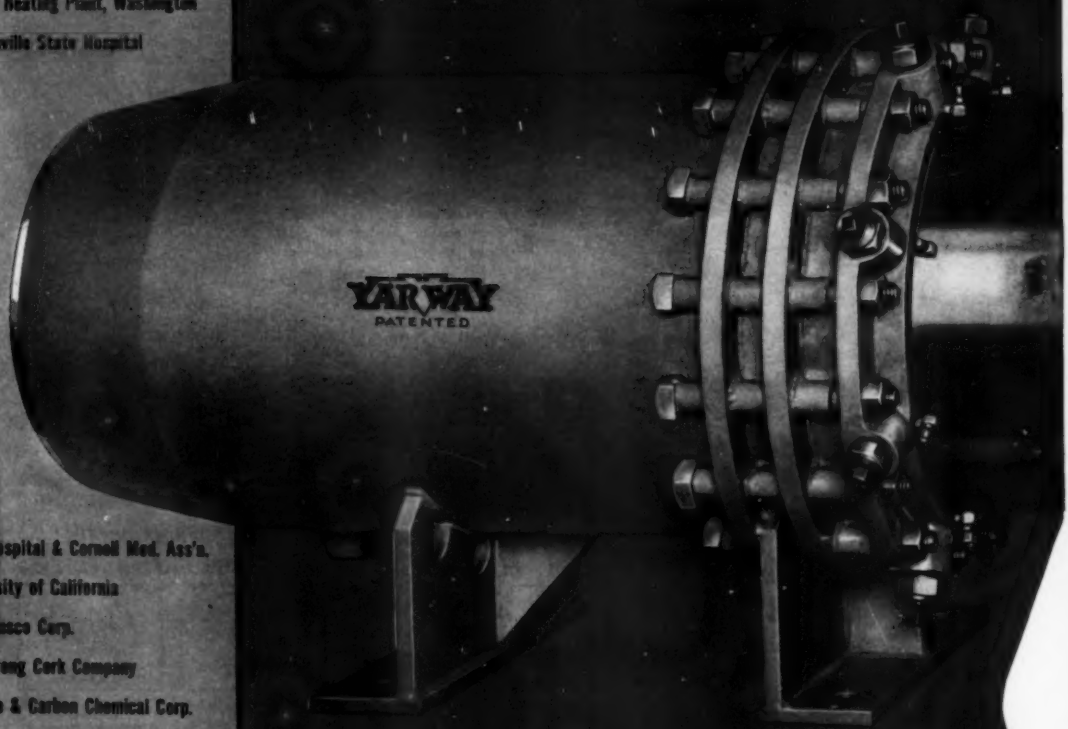
SOLD ONLY DIRECT FROM FACTORY

TYPICAL USERS

Allegheny Co. Steam Heating Company
Sanitary District of Chicago
City of Cleveland
Florida Power & Light Company
Georgia Power Company
Philadelphia Electric Company
Dayton Power & Light Company
Camarillo (Cal.) State Hospital
Central Heating Plant, Washington
Jacksonville State Hospital

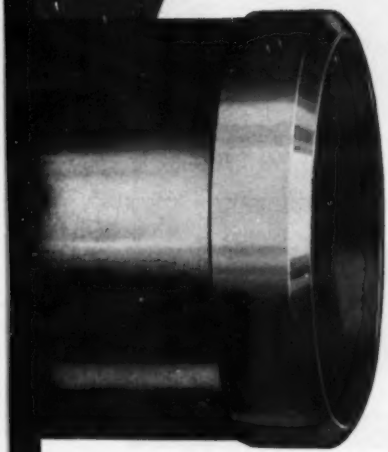




N.Y. Hospital & Cornell Med. Ass'n.
University of California
Agfa Ansco Corp.
Armstrong Cork Company
Carbide & Carbon Chemical Corp.
Chrysler Corp.
General Motors Corp. (Buick Div.)
General Motors Corp. (Chevrolet Div.)
Westinghouse Electric Co.
West Central Heating Plant, Wash., D.C.
University of Washington
Public Service Company of Colorado

YARWAY

FREEDOM FROM SHUTDOWNS



Yarway Single-end Gun-Pakt Expansion Joint, welding type. Double-end and flanged types also available.

What feature do you want most in an expansion joint . . . sure movement, simplified installation, ease of servicing, low cost, low upkeep?

Yes, they're all important. But when you're dealing with steam under pressure, *there's nothing more important than reliability—freedom from shutdowns.*

The high factor of safety in Yarway Gun-Pakt Expansion Joints prevents shutdown losses—eliminates accident hazards.

Gun-Pakt Joints are *rugged* joints, strong and dependable. They are *serviced under full steam pressure.* Packing is added simply by inserting a plug of Yarway plastic packing and turning a wrench . . . the joint's tight, the job done.

FEWER JOINTS NEEDED

With Yarway Gun-Pakt Joints you need fewer joints per length of pipe line. Each sliding sleeve may have a traverse of either 4", 8" or 12" . . . maximum expansion being 24" for a double-end joint.

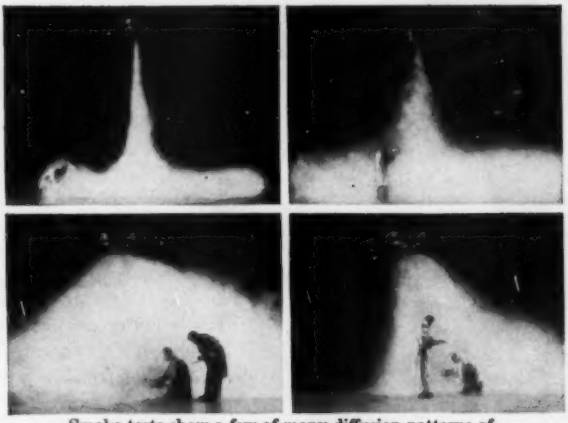
Gun-Pakt is more than just another expansion joint—it is a revolutionary idea in expansion joint engineeri... success is shown by wide use in lead... stations, institutions and ...

Get ...

GUN-PAKT EXPANSION JOINT

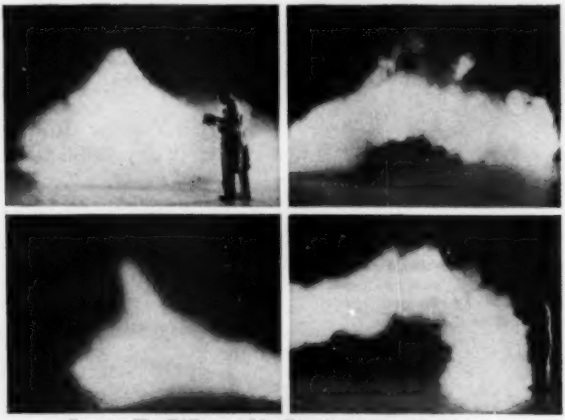
Patented diffusers on TRANE unit heaters put heat right where it's needed!

EXCLUSIVE LOUVER CONE DIFFUSER on TRANE Projection Heater concentrates hot air stream for additional throw. Diffuses heat gently, directs it where needed, pinpoints cold spots—all with finger tip control. It taps waste ceiling heat, projects it down to floor line. Ideal for craneways, aisles, bays, hundreds of other places.



Smoke tests show a few of many diffusion patterns of Projection Heater with Louver Cone.

EXCLUSIVE LOUVER FIN DIFFUSER gives new versatility to the TRANE Model H horizontal discharge unit heater. Countless diffusion patterns are now available—divided streams, gentle blanket, spot throw. TRANE also makes the Torridor, a blower unit for large volume heating, deluxe cabinet units and gas fired units. All in a complete range of capacities.



Louver Fin Diffuser adds directional control to horizontal discharge Unit Heater.

TRANE Float Trap (shown), TRANE bucket traps and thermostatic traps are matched to TRANE Unit Heaters to give perfect results for either high or low pressures.

For complete information about how TRANE Unit Heaters and Diffusers can solve your heating problems, see your nearest TRANE sales office or write TRANE at La Crosse, Wisconsin.

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

TRANE

THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division, Scranton, Pa.
Trane Company of Canada, Ltd. . . . Toronto
Offices in 80 U.S. and 14 Canadian Cities

Announcing

THIS SALT-SPLITTER SYSTEM removes both alkalinity and hardness by means of two resin beds in one tank. Needing only inexpensive salt — no acid — for regeneration, it offers these advantages:

1. Permits operation at alkalinities approaching zero, since no acid is present to damage equipment or produce acid water.
2. Eliminates costly rubber- and lead-lined tanks and piping.
3. Simplifies disposal of spent regenerant.
4. Provides complete safety for operating personnel.

Users of sodium zeolite softeners who find them unsuitable because of the high alkalinity of the effluent or who may be by-passing raw water for boiler make-up should definitely investigate the possibilities of incorporating this system into present installations.

For a concise explanation of the operation of this new combination of two proven water-conditioning methods, get a copy of the new Allis-Chalmers bulletin, 28X7808. Just fill in and mail the coupon.

Allis-Chalmers
Milwaukee 1, Wisconsin

Please send Bulletin 28X7808 describing alkalinity reduction by ion exchange.

Name

Title

Company

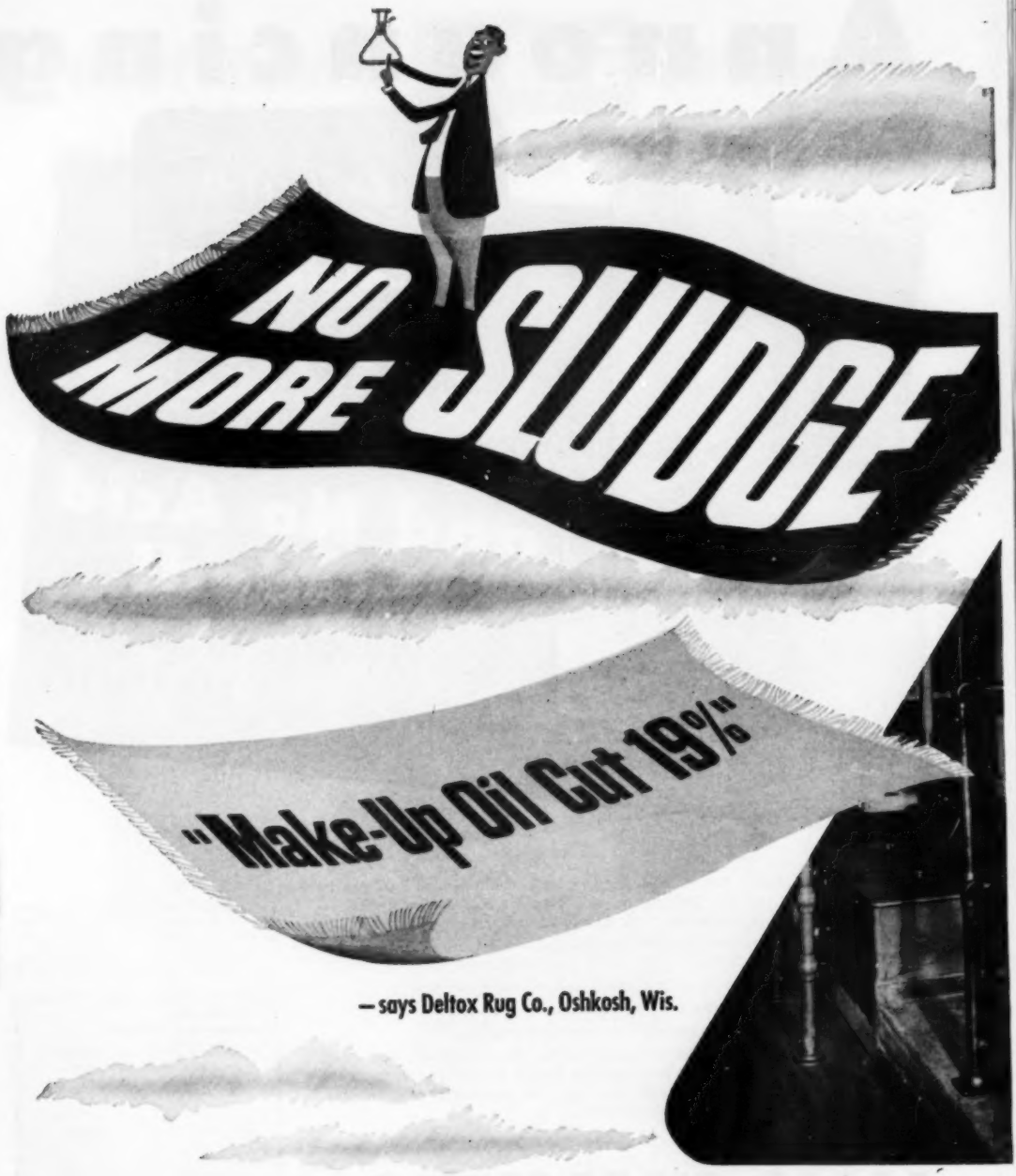
Address

City State A-3615

ALLIS-CHALMERS

Water Conditioning

✓ EQUIPMENT ✓ CHEMICALS ✓ SERVICE



SINCLAIR OILS

Fine, smartly-designed fibre rugs made by the Deltox Rug Company are favorites with budget-wise consumers from coast to coast. The Deltox plant, in Oshkosh, Wis., generates its power with an Ames 4 cyl. Uniflow Steam Engine, shown here.

At first, this engine was giving Deltox engineers trouble with sludging and oil emulsification in the circulating system. Then, about a year ago, Deltox changed to Sinclair RUBILENE® Oil Medium. The gauge glass was watched vigilantly, but there was no evidence of emulsification or developing sludge.

Besides ending emulsification and sludging, the subsequent yearly overhaul showed practically no valve cam or bearing wear; and carbon deposits in the valve gearing were negligible. Furthermore, a check of past records showed a cut of 19% in make-up oil.

Are you getting full satisfaction from the circulating systems in your plant? Perhaps a Sinclair Engineer can save you maintenance and operating expense. Get in touch with your nearest Sinclair Representative, or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

MAKING A CHECK. Sinclair Rubilene shows complete separation from water.

for circulating systems

...as much as 65% to 80%
BY
CHAPMAN
Tilting Disc CHECK VALVES

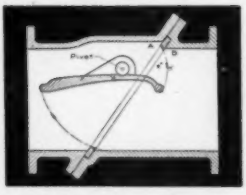
Typical test on a 22-inch Chapman Tilting Disc Check Valve under 450 pounds gas pressure . . . carrying 3,200,000 feet of gas per hour . . . showed a drop in pressure of less than 7 inches of water.

The average reduction of head loss . . . as against conventional check valves . . . is 65% to 80%.

That's because the balanced hinge-pinned disc, of special aerofoil design, has exceptional lifting qualities, lightness in unbalanced weight, and minimum resistance to flow in open position. And valve body is streamlined, with through-way always equal to the area of the pipe.

This means that *disc won't slam* under usual piping arrangements ...and that it seats drop-tight. It means, too, that many new lines can be designed in smaller size. Send for Catalog No. 30, giving complete data and test-curves on Chapman Tilting Disc Check Valves.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS



Cross-section of the Chapman Tilting-Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

Photos Courtesy The Austin Company
Engineers and Builders

4 UNION BOILERS *at* THE UPJOHN COMPANY

Fine Pharmaceuticals Since 1886

KALAMAZOO 99, MICHIGAN

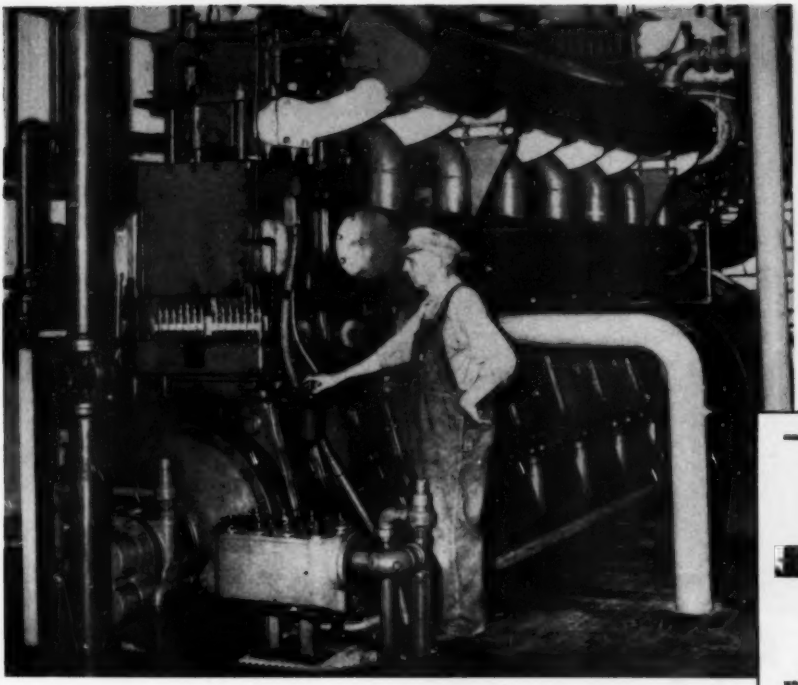
EACH of these 4 coal fired Union "A" Type Boilers delivers 60,000 lbs. of steam per hour 175 psi—sat., for heat and process requirements at the new Upjohn Plant on Portage Road, Kalamazoo, Michigan. Their design provides for gas or oil firing if necessary. The Upjohn selection charges these Union Boilers with supplying steam for some 33 acres of modern plant under roof, where over 700 world-famous Upjohn pharmaceuticals are produced. Known for fine pharmaceuticals since 1886, Upjohn selects every unit upon which production depends with critical eyes. You can fully depend upon Union to furnish correct steam generating units for your specific requirements. You will profit by consulting with Union engineers.

The Upjohn boiler plant building is designed to accomodate 2 more boilers when needed. The 50 ton per hour coal bunker overhead is designed with weigh-larry to serve boilers on both sides of the boiler room.

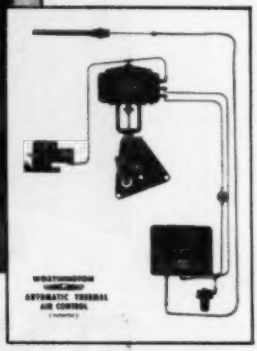
UNION IRON WORKS . . . *Since 1890*

373 CASCADE STREET • ERIE, PENNA.

BOILERS • PROCESS EQUIPMENT • FABRICATED STEEL



WORTHINGTON 1,000-KW CAPACITY SUPERCHARGED DUAL FUEL DIESEL used in conjunction with municipal steam generating plant at David City, Nebraska.



Cost-per-kw down over 60% with Worthington Dual Fuel Engine

David City, Nebraska—this city has proof that the Worthington Dual Fuel Diesel can reduce power-plant operating costs.

Engineering of this installation—made in August, 1949—was under the direction of Black and Veatch, Kansas City, Mo., Consulting Engineers. At the present time the unit operates at only one-third capacity in supplementing steam power generation.

In spite of these poor load conditions, the David City plant's overall operating cost per kw was down 60% the first year this engine was used.

ONE BIG REASON YOU GET MORE EFFICIENCY FROM THIS ENGINE

Worthington's Automatic Thermal Air Control—an exclusive patented Worthington feature—is one of the biggest reasons you get more efficiency from this dual fuel engine—or from Worthington gas engines.

Unlike any air throttling mechanism dependent on governor action, this unit is actuated by engine exhaust temperature.

It maintains optimum air-fuel ratio at all times; provides automatic variation of air quantity in direct relation to ambient air temperatures; automatically compensates for changes in the heating values of the gas fuel (this would require manual adjustment where air-throttle controlled governor is used); maintains highest fuel economy at all loads regardless of changes in air temperature or fuel quality.

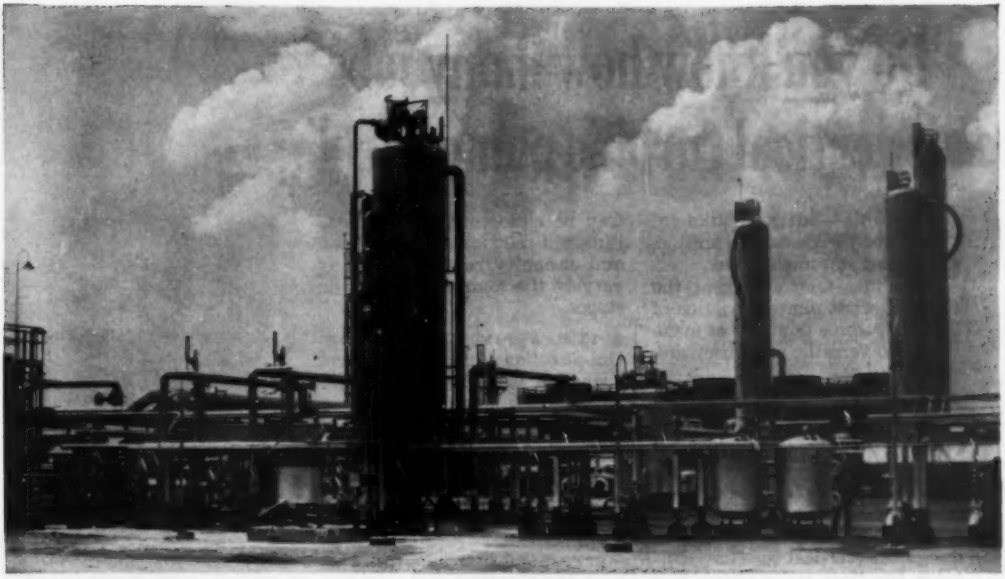
Worthington engines can increase *your* plant's efficiency and lower operating costs. For more facts on Dual Fuel or other engines, gas or Diesel, write Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.

E.133

Worthington-Built Auxiliaries

Economical Continuous Power—Diesel Engines, 150 to 2,640 hp . . . Gas Engines, 190 to 2,880 hp . . . Dual Fuel Engines, 150 to 2,640 hp.

WORTHINGTON
Engines



NORTH COWDEN GASOLINE PLANT near Odessa, Texas, operated by Stanolind Oil and Gas Company. Here Worthington Water Softeners protect boilers from scale-forming deposits.

Worthington softeners protect this plant's boilers 10 ways

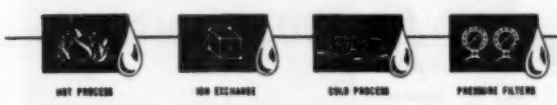
In this case, it's a hot-process softener to remove scale-forming deposits from boiler feedwater.

Let's examine this gasoline plant installation and see how it gives boilers "maximum" protection:

1. *Feed water is softened* by a hot-lime soda system.
2. *Selective deaeration* for operation on make-up only, condensate only, or both.
3. *Non-scaling direct-contact vent condenser* heats and vents treated make-up.
4. *Tubular vent condenser vents condensate.*
5. *Oxygen contamination of feedwater avoided* by last-step deaeration.
6. *Stainless steel deaerating elements.*
7. *Uniform and efficient deaeration* during wide load swings.
8. *Filter backwashing* with clean, hot, chemically inert water without velocity change through the softening zone.
9. *Proportionate sludge removal.*
10. *Uniformly proportionate chemical feed.*

Before you buy, investigate Worthington Water Softening Systems thoroughly. Tell us the service conditions, and get our recommendations in terms of dollars and benefits. We're certain you'll learn that *there's more worth in Worthington.* Write Worthington Pump and Machinery Corporation, Water Treating Section, Harrison, N. J.

J.J.A



Worthington Makes More of the Equipment for ALL Types of Water Conditioning Systems

WORTHINGTON

Water Conditioning

Do you know how many jobs this vertical turbine pump can do?

We don't—but we'd like to! We've got an idea there are lots more than you might think.

Let's first take a look at the four inherent characteristics of vertical turbine pumps that make them the versatile units they are.

1. THE DRIVE UNIT IS REMOTE AND SEPARATE FROM PUMPING ELEMENT. The pump always operates submerged. No priming. No expensive dry pits, no suction or NPSH problems.

2. SPACE REQUIREMENTS AT A MINIMUM. Because of its vertical design, the vertical turbine pump takes less floor space than other types.

3. MECHANICAL AND HYDRAULIC FLEXIBILITY. Will operate with any type of drive. Discharge can be positioned to user requirements. Can be close coupled or several hundred feet long. Meets head and capacity requirements by varying the number of duplicate stages.

4. IT'S A SIMPLE MACHINE. Uni-directional thrust minimizes alignment problems. Easy maintenance, few moving parts, little friction, long life.

Have you thought of a vertical turbine pump for your application? We'd like to hear from you, send you full information on Worthington vertical turbine pumps—newest and broadest line of its kind, built by the *oldest* manufacturer of pumping equipment.

Worthington Pump and Machinery Corporation, Vertical Turbine Pump Division, Denver 16, Colo.; Succasunna, N. J.

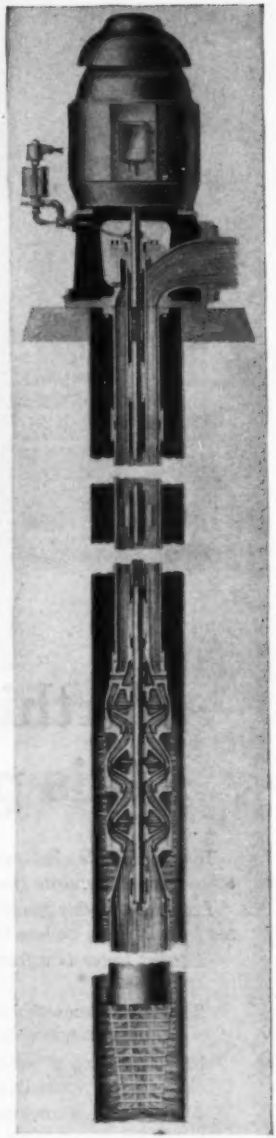
CHECK WORTHINGTON AGAINST THE REST

Only Worthington has all 8 vital design features as standard equipment.

The Ten Leading Makes Of Vertical Turbine Pumps
● Indicates Feature Is Standard

Standard Features	Worthington	Pump A	Pump B	Pump C	Pump D	Pump E	Pump F	Pump G	Pump H	Pump I
Seals above and below drain ports (oil-lubricated model)	●									
Wearing rings	●				●			●		
Enclosed impellers	●	●	●	●	●	●		●	●	●
Bronze bushings in bowl assembly	●		●	●	●	●		●	●	●
Flanged and bolted bowls on all sizes	●						●		●	●
Sand collars at both ends of bowl assembly (water-lubricated model)	●	●								
Grease-packed bottom bearing	●	●		●	●					●
Choice of oil or water lubrication	●	●	●	●	●	●		●		

The reasons why Worthington Vertical Turbine Pumps are out in front of competition.



Typical section of the Worthington oil-lubricated vertical turbine pump that gives most efficient pumping performance at lowest possible cost.

D.1.10

The World's Broadest Line Assures You The Right Pump For Every Job

WORTHINGTON

Vertical Turbine Pumps

fluor's modern research facilities

test new developments — verify efficiency

At Fluor, the proof of the design is in the testing. *Before* new Cooling Tower developments are incorporated into standard design, they are subjected to rigorous tests in this modern, commercial-size tower testing laboratory. Here, design and performance efficiency of every new development is determined through complete ranges of actual heat transfer conditions. Realistic rating data is established under conditions *paralleling* those of plant and process operations.

Fluor Cooling Tower Testing Facilities. This commercial-size installation consists of a pump house, instrument house, 20,000,000 BTU/H boiler, test basin, and a 40' high test tower.

What this means to you . . .

The motivating power behind Fluor's continuous research and development program is to *always* provide the most efficient cooling tower available. This fact, combined with Fluor's 30 years of active experience in designing major cooling tower installations for the petroleum, chemical, and power industries, means many things to the man seeking a factual tower recommendation to meet his exact cooling requirements.

A Fluor Cooling Tower recommendation means that all variables are included and compensated for. It means that all component parts, as well as all design theory, have been tested and evaluated under actual operating conditions. And, it means that a Fluor-designed cooling tower will perform at *rated* heat transfer efficiency under the conditions of installed operation. *You can be sure with Fluor!*

FLUOR

Designers - Engineers - Constructors - Manufacturers

THE FLUOR CORPORATION, LTD., 2500 S. ATLANTIC BLVD., LOS ANGELES 22, CALIF.
New York, Chicago, Pittsburgh, Boston, Tulsa, Houston, San Francisco, Birmingham and Calgary

Represented in the Sterling areas by:
Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.1., England

So much easier... It's used more often

More people use Worthington's QD sheave than any other . . . because it's *easier*.

It's the only one on the market that gives you the choice of mounting in two pieces or preassembled.

It's the only one that makes switching sheave sizes really easy—the hub stays put, there's no realignment problem.

It's the only one with a *lock* to keep the shaft key from drifting.

You'll find it's *stronger*, too. Worthington is the only manufacturer to design each size individually for the load—rather than to proportion all sizes from one design. I-beam spokes carry heavier load with less weight.

Put Worthington QD on your drives and take a load off your men. Hubs and sheaves are available in a wide range of sizes and HP.

Worthington distributors carry complete range of stock sizes. The QD design is also licensed to other sheave manufacturers with dimensions standardized for interchangeability.

Write for Bulletin V-1400-B7F. Worthington Pump and Machinery Corporation, Multi-V-Drive Sales Division, Buffalo, N. Y.

1. Light hub goes on first . . .

2. Then heavier rim slides on

3. Or mount both hub and rim together

Worthington QD

Trade Mark Pat. No. 2269821

ORIGINAL TAPERED CONE-GRIP SHEAVE

Most Widely Used Hub and Rim Combination

Split hub is clamped to shaft. Heavier taper-bored rim slides easily over tapered hub—no keyway obstruction on cone surface. Positive press fit on shaft. Large, long pull-up bolts also used as jack screws to remove rim.

WORTHINGTON

THE GOOD RIGHT HAND OF INDUSTRY

POWER TRANSMISSION: sheaves, V-belts, variable speed drives

PUMPS: centrifugal, power, rotary, steam

AIR COMPRESSORS: water-cooled, air-cooled

How to speed up speed changes

an idea "Kicked in" by a WORTHINGTON DISTRIBUTOR

Pye-Barker Supply Co. of Atlanta comes through with *this* idea.

Many of its textile mill customers receive orders for yarns of different sizes. In processing these different sizes, speed changes—particularly on spinning frames—must be made often and quickly.

Pye-Barker, Worthington distributor, had the answer—Worthington QD sheave—the sheave that lets you change rims for speed variation without disturbing alignment. Why? Because the hub stays in place and the new sheave bolts easily and quickly in proper alignment.

To make the operation even faster, the textile mills painted the various rims a different color, one for each speed variation required—assuring the right rim, the right speed, and proper alignment.

MV.1.BA

STOP RUST! with RUST-OLEUM

Protects Tanks, Pipes, Girders, Metal Sash, Fences, Roofs and Buildings, Rail and Marine Facilities

BEAUTIFY AS YOU PROTECT—ALL COLORS, ALUMINUM AND WHITE!

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THE ANSWER...

A Graver Hot Process Softener System

The Graver System was selected by the Company's consulting engineer for these outstanding advantages... the *modern economical design* of Graver equipment... its *low operating cost* ... its *proven performance* for more than 40 years... and *single responsibility* because of Graver's ability to furnish *all* required equipment, fabricated in its own plants.

THE RESULTS OBTAINED:

TOTAL HARDNESS: ...reduced to less than 1 ppm

SILICA: ...reduced to less than 1 ppm

If you have a water problem, write to Graver for authoritative recommendations.

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EQUIPMENT IN THIS PLANT

- 2—33,000 gph Type S Hot Process Softeners with internal vent condensers and chemical feeders.
- 1—66,000 gph second-stage phosphate softener.
- 2—500,000 lb per hr stainless steel-clad Tray-Type Deaerating Heaters.
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- Acid Feeding system to reduce pH.
- All accessories.

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GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

Dept. IP-HP, 216 West 14th Street, New York 11, N. Y.

GW-483

Modern new Steam Plant of **Fairbanks-Morse & Company, Beloit, Wisconsin,** home of the famous opposed-piston diesel engine . . . designed and built by **Stone & Webster.** Included are three new Westinghouse Centrafire Traveling Grate Stokers. Each is capable of producing 80,000 lbs. of steam per hour. This outstanding plant was placed in operation during March, 1951.

1/3 less coal

with same load

Three Westinghouse Centrafire® Stokers with Traveling Grate, installed at the new Fairbanks-Morse Steam Plant, are establishing an impressive record of efficient and economical operation. Previous stokers operating under identical temperature and load conditions burned approximately 50% more coal than now is required by the new Westinghouse Centrafire.

Each pound of coal now produces more steam due to more complete combustion with a minimum of excess air. Accelerated response to changing steam loads makes operation easy. Requirements for operating and maintenance personnel have been cut considerably.

You can have the operating economy . . . flexibility . . . and reliability of a Westinghouse Stoker with any boiler of your choice. To get the full story, phone your nearest Westinghouse Stoker Application Engineer, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-50533

YOU CAN BE SURE . . . IF IT'S
Westinghouse
STOKERS

cuts the heating cycle on presses... by 7 minutes

PROBLEM: What to do when production requirements call for a speed-up in the heating cycle.

SOLUTION: (A typical one supplied by a western molded-rubber plant) Equip presses with Yarway Impulse Steam Traps.

RESULT: Heating cycle now 8 minutes instead of their usual 15, a saving of nearly 50%.

Yarway Impulse Steam Traps are designed **to get equipment hotter, sooner, and keep it hot**—thereby increasing production. In operation, Yarways send the most premium B.T.U.'s at top temperatures into your product or process.

Other reasons why over 750,000 Yarways have already been installed are—one moving part, low maintenance, small size, easy installation, good for all pressures, made of stainless steel, low cost.

It's easy to buy Yarway Impulse Steam Traps. One of 216 industrial distributors who stock and sell them is located near you.

FREE! NEW TRAP SELECTOR
The right steam trap in the right place is important. Find quickly and easily which *is* the right Yarway trap for each application in your plant. Write for your free copy of this new 16-page Selector.

YARWAY

the steam trap designed with production in mind

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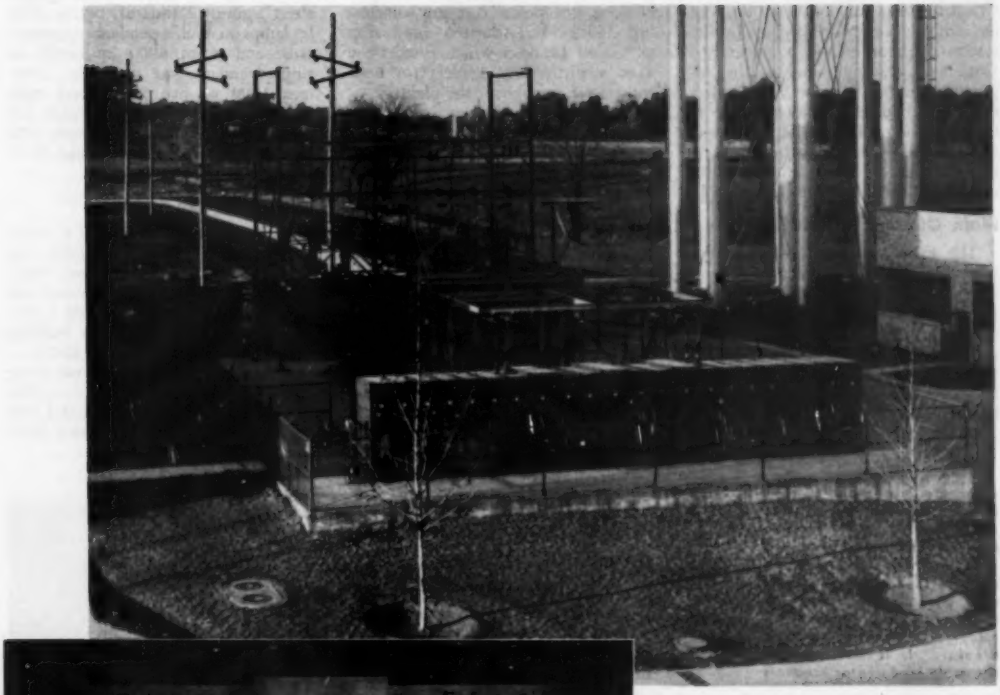


Duplication of the power service starts with utility lines. Main substation transformers with primary and secondary ties supply 4.16 kv buses in outdoor switchgear that saves building space

Flexible and Reliable Distribution for a WESTERN ELECTRIC PLANT

GEORGE R. AYER, *Electrical Engineer*
Western Electric Company, Inc.

Here is modern electrical distribution designed for a heavy lighting load, moderate numbers of high voltage motors and a normal power load. Low cost reliability is combined with flexibility and easy maintenance in all the power services

LATEST MANUFACTURING plant to be added to the Bell System, the Indianapolis Plant of Western Electric Company, Inc. was recently completed and is now in full production of telephones. Ideally located on the outskirts, approximately 6.5 miles northeast of the city's center, the plant employs upwards of 6000 people. Electrically, it was designed for a connected load of 25,000 kw and an hourly demand of 10,000 kw.

Power is purchased from the local utility, The Indianapolis Power and Light Company, and is supplied over two 33 kv lines feeding double banks of three 2500 kva, 33/4.16 kv transformers located in an outdoor combination utility and plant substation in the approximate center of the 133 acres of ground. Means of cross connecting these transformers on both the primary and secondary sides are provided; and duplicate 4.16 kv services are delivered

to the plant site at the substation. Oil circuit breakers for the 33 kv line can be remotely controlled by the utility system operator or can be controlled from an operating panel in the adjacent plant boilerhouse. The power company's two 33 kv lines originate at two substations in widely separated sections of the district, each substation being tapped off a 132 kv loop which completely surrounds the city.

Main Outdoor Substation

The main outdoor substation contains the metal clad switchgear, buses and street lighting regulators and is adjacent to the enclosure for the power company equipment. The duplicate power services feed through oil circuit breakers into a 4160 v bus which can be sectionalized by a non-automatic oil breaker, all equipment being rated 2000 amp. The metal clad switchgear houses, in addition to the three oil breakers, the power company's metering cubicles and fourteen 1200 amp oil circuit breakers which protect the 4160 v distribution feeders for light and power throughout the plant.

All electrical equipment in the substation is of the 5000 v class with the exception of the main bus, which is insulated for 15,000 v. At one side of the metal clad switchgear is a transformer pad containing two 15 kw street lighting regulators, both controlled by one astronomical time switch for series street lighting.

Outdoor Lighting

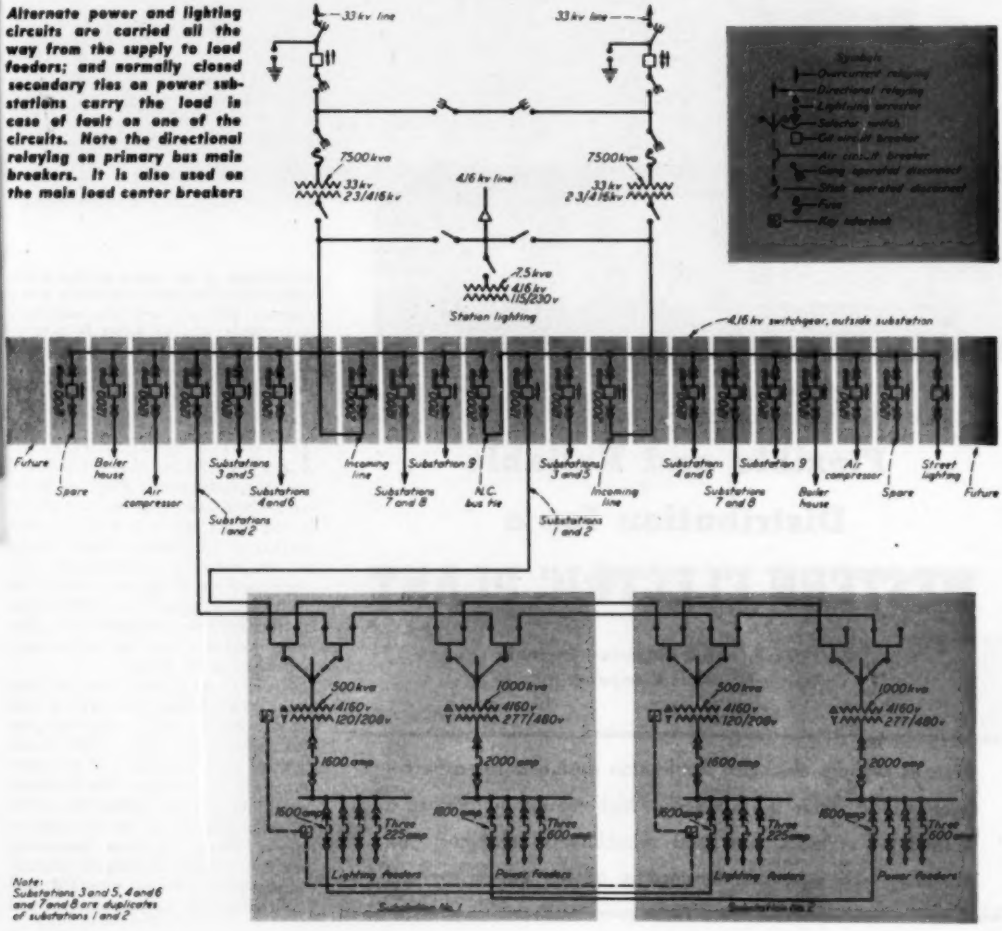
The 9000 ft of roadways, 7000 ft of walkways and two parking lots which have a total capacity of 2500 cars are lighted by 26 kw of series street lighting and 38 kw of multiple street and floodlighting. There are forty-six 6000 lm and six 300 w lamps on 52 upright street lighting standards, twelve 6000 lm lamps on double pendant type standards, and seven 6000 lm lamps on single pendant type standards. Fourteen 1000 w, five 500 w and eight 300 w floodlights light the roads and walks. Parking lots use seventeen 1000 w floodlights mounted on four 40 ft tubular steel poles.

Manufacturing Building

Eight of the fourteen 4160 v feeder breakers supply four 1000/1250 kva, 4160/480 v and four 1000 kva, 4160/480 v unit substations for power and eight 500 kva, 4160/120/208 v substations for lighting in this building of almost 25 acres of floor space.

Forced air cooling of all power transformers has been provided for; four are now equipped with fans and four will have them added if future loads

Alternate power and lighting circuits are carried all the way from the supply to load feeders; and normally closed secondary ties on power substations carry the load in case of fault on one of the circuits. Note the directional relaying on primary bus main breakers. It is also used on the main load center breakers



Note:
Substations 3 and 5, 4 and 6 and 7 and 8 are duplicates of substations 1 and 2

warrant their use for greater capacity.

Each of the 16 unit substations is equipped with double throw primary switches permitting the selection of one of two feeders. All transformers are tied together in pairs on the low voltage sides through 1600 amp air circuit breakers and low reactance busway. 1600 amp, three phase, three wire busway is used for power transformer ties, and 1350 amp, three phase, four wire, busway connects lighting transformers. With this primary and secondary selective arrangement, the sectionalized main bus, and the duplicate power company services which can be cross-connected on both sides of the transformers, it is felt that this system is economical, flexible and reliable. Loads are easily added and transferred and, in the case of trouble, down time is reduced to a minimum.

Unit substations for power are operated with bus-tie breakers closed, the main secondary breakers being equipped with reverse current relays. The lighting substation tie breakers are normally open, the main and bus-tie breakers being key interlocked so that one is open at all times. A combination of one lighting substation and one power substation is situated in each of six 40 x 40 ft penthouses.

Ventilating Fans

Motors that operate the 39 large ventilating fans form a sizeable block of service load in this building. The fans have a total maximum capacity of 2,678,000 cfm of air and constitute a 760 hp motor load. Thirty-two motors and fans are located in penthouses, saving considerable valuable floor space.

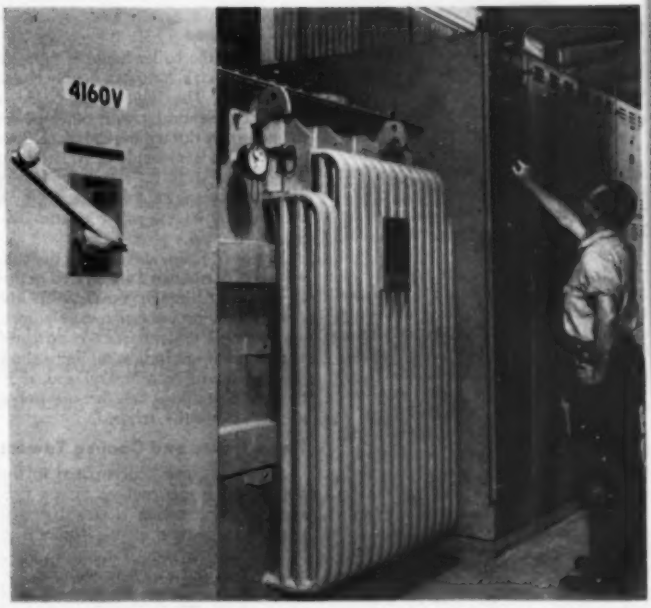
Power at 460 v is distributed throughout the building by 34 runs, averaging about 600 ft each, of 600 amp, three phase, three wire, plug-in bus duct. There are forty-nine, 3/0, 120/208 v lighting feeders from which an average of six 50 amp, three phase contactors per feeder are tapped. Push button control of each contactor lights areas of about 4200 sq ft. Lighting in this building is from approximately 7500 two-lamp, 85 w porcelain enameled industrial fluorescent fixtures.

Fixtures are suspended on 50 amp single phase trolley duct supported on messenger cable. Levels of illumination maintained are 22 to 25 ft-c. Reflectors have several apertures in both sides of the top, and about 5 per cent of the light is thrown upward into the truss space, thereby reducing contrast. According to photometric tests made on the fixtures, this amount of upward light did not lessen the amount thrown downward.

In special manufacturing areas two lamp, 40 w fixtures were used. General lighting is supplemented by local lighting where needed. Two lamp, 40 w treated aluminum troffers were chosen for installation in the cafeterias, recreation rooms, laboratories and first aid rooms to provide illumination levels of 30 to 35 ft-c. The entire system was designed with the possibility of having to double the illumination in the future.

Each lighting substation has an adjacent 40 amp-hr, automatically charged battery for emergency lighting and is controlled so that the emergency lighting and exit lights are switched to the

Part of the 7500 fluorescent fixtures used in the manufacturing building are shown above. They are supplied by 50 amp single phase trolley duct suspended from messenger cable; provide nearly 25 ft-c of illumination



One of 16 unit substations, this 1000 kva unit is typical. Reverse current relays on the main secondary breakers permit normally closed secondary ties, selective primaries. Transformers may have forced air cooling added later

Troffers are used in cafeterias, recreation rooms, laboratories and the like. Above, the second floor of the office building is shown. The entire lighting system was designed for possibility of doubling illumination

battery if a transformer should go out of service. This will provide enough light for safe evacuation of the area concerned.

Office Building

The office building is a two story structure totaling 75,000 sq ft of floor area. Fourteen hundred two-lamp, 40 w aluminum troffer units are used for lighting this building to provide illumination levels of 30 to 35 ft-c. This system, like the one in the manufacturing building, was designed for double the present levels. A lighting substation of 500 kva capacity is located in a basement and is similar to the lighting units in the manufacturing building.

The small amount of power required for this building is supplied from a plug-in busway in the manufacturing building. One of the features of the building is a fully equipped hospital, containing operating rooms, examining rooms, first aid rooms, wards, a hydrotherapy room, X-ray rooms, a clinical laboratory and doctors' and nurses' rest rooms. Special lighting and power applications were met in the electrical design of this area.

Boiler House

Load in the boiler house is supplied at 460 v from a 2000 kva double ended substation. The high voltage side is equipped identically with other power transformers throughout the plant. Two 4160 v feeders supply a synchronous motor load of 1500 hp controlled by completely automatic starters and operating five 1650 cfm rotary air compressors at 100 psi.

Power company meters and the supervisory control panel are located in this building. Although breakers in the main substation are not remotely operated, a mimic switchboard was provided in this building. Indicating lights show the position of each breaker and, if in the open position, whether or not it was automatically tripped.

Pump House and Cooling Towers

A 375 hp load concentrated in the pump house and cooling towers presented an interesting electrical design problem. Function of this system is to provide cooling water for various process and service equipment within closely controlled limits of pressure and temperature. With an average use of 1500 gpm, it was necessary that the system be of the recirculating type for the conservation of water. To achieve these operations, a hot well was provided to collect the return water from the process equipment cooling water.

Three 1200 gpm vertical turbine pumps powered by 30 hp squirrel cage vertical motors were needed to send the hot return water to the two cooling towers. Three 1200 gpm centrifugal pumps powered by 75 hp squirrel cage motors provide the required head to move the cooled water back into the cooling water piping system. Operation is fully automatic and regulates flow, pressure and temperature of the cooling water .

Operation of the 30 hp turbine pumps is controlled by a multiple float switch equipped with transfer plugs for alternating the pump sequence. The 75 hp centrifugal pumps are controlled by pressure operated switches likewise equipped with transfer plugs for alternating the pump sequence. Temperature control is provided by thermostats causing valves and fans to operate in the cooling water system.

At normal low water temperature the cooling water is collected in the hot well and pumped directly into the cooling water system. On rising water temperature, thermostats operate additional valves and the water is pumped from the hot well up and through the cooling towers and then into the cooling water system. If water temperature continues to rise, thermostats cause the cooling tower fans to operate for a further cooling effect.

Conclusion

The entire electrical installation at this plant has operated satisfactorily during the past year of load buildup. Electrical down time has been negligible and it is felt that the installation was built and is being operated very economically. Flexibility was of the utmost importance in the design and sufficient spare capacity to take care of future expectations was provided.

The installation is the product of combined efforts of the engineering departments of Western Electric Company and Allen and Kelley, Architect Engineers. The electrical contractor was Hatfield Electric Company.

PRINCIPAL EQUIPMENT AT THE WESTERN ELECTRIC INDIANAPOLIS PLANT

Metal clad switchgear	Allis-Chalmers Manufacturing Co.
Unit substations	Allis-Chalmers Manufacturing Co.
Cables	Habirshaw Cable and Wire Corp.
Batteries and automatic chargers	Electric Storage Battery Co.
Batteries and automatic chargers	Nickel Cadmium Battery Corp.
Lighting fixtures	Day-Brite Lighting, Inc.
Bus duct, trolley duct, lighting panels	BullDog Electric Products Co.
Automatic pressure pump and float controls	Automatic Control Co.
Automatic temperature, pump and fan controls	Johnson Service Co.
Ventilation controls	Johnson Service Co.
Compressor synchronous motors and controls	Westinghouse Electric Corp.
Motors	Westinghouse Electric Corp.
Lighting controls	Allen-Bradley Co.
Motors	General Electric Co.

Accuracy of and Basic Reasons Behind

STEAM PRESSURE CONTROL

Steam pressure is nearly always controlled by its own variations. This fundamental discussion explains why, the results that can be expected and forms the basis for succeeding articles on steam plant control

W. H. PUGSLEY, *Vice President*
The Hays Corporation

THE QUESTION almost invariably raised when considering installation of automatic combustion control is accuracy of pressure regulation. As a premise, steam pressure cannot be held "constant" at all times if the basis for operation of a control system is change in steam pressure. It is still the best method, however, and variations can be held to a satisfactory minimum.

Several factors which determine limitation of pressure variation are:

1. Character of the plant load.
2. Character of the steam generator.
3. The control equipment itself.

Load is important from the standpoint of pressure control. Yet in most cases, it must be taken "as is" and handled in the best manner possible. Often better control may be established by using steam for other purposes to secure a more favorable load condition. Of course, anything that can be done in this direction is a benefit to efficiency as well as to the control of pressure. This refers especially to the reduction of peak loads.

The more constant the load, the more uniformly the steam pressure can be maintained. The load that varies widely, but gradually, over a long period of time is more easily controlled than one that fluctuates considerably at frequent intervals. Rapidity and extent of these variations are determining factors as to how uniformly steam pressure can be maintained as far as the load character is concerned.

Base loads in power generating plants, and some types of continuous industrial processes, are constant and easily controlled. Building heating loads, independent or municipal electric light plants, city water pumping loads and some industrial plant loads increase gradually and may remain constant and fall off slowly later on as demand decreases.

Industrial plant loads, such as mines, quarries and test loads where the equipment being tested is loaded and unloaded rapidly and frequently, swing widely and require fast, accurate control.

Generally, satisfactory pressure control can be secured regardless of load

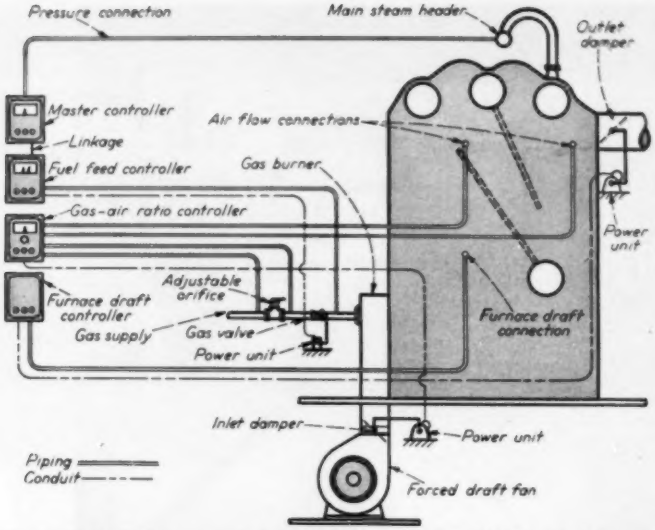


Fig. 1—Most satisfactory method of controlling all types of fuel feed is by steam pressure, often modified by steam flow. Master control unit normally aids in maintaining the efficiency by interaction with fuel, air-ratio and draft controls

character, since the tendency today is to select steam generating, fuel burning and auxiliary equipment suitable to the load.

The design of the steam generator, (type of boiler, setting, fuel and fuel burning equipment) enters into the ability of the unit to respond to adjustments made by the control in response to steam pressure changes.

Steam Generator

The greater the water storage capacity of the boiler the slower it will respond to load changes due to its greater heat absorbing capacity. Modern boilers which approach a "flash" type unit respond very rapidly, compared to the older large tube, large water capacity units.

Generally speaking, boilers burning fuels in suspension, Fig. 2, will respond more quickly to changes in fuel input than will those burning solid fuels entirely on grates, Fig. 3. However, other factors such as availability or cost of fuel will also enter into selection of firing equipment.

Solid refractory settings, due to their greater heat retaining capacity, are less responsive to changes in heat input than are air-cooled or thin, insulated walls, having lower heat capacity. Water-cooled walls hasten response of the unit to changes in firing because of the rapid change in heat absorption that takes place, and because of lack of stored heat.

With the proper combination of boiler, fuel, fuel burners and settings, even the most difficult load may be controlled. Experience indicates that load changes of 15 to 20 per cent of capacity of the unit per minute can be handled without loss of efficiency or pressure control.

Control Equipment

It is assumed in making the above statements that a complete metering system of control is being considered and, therefore, best efficiency, as well as pressure control is to be secured.

It is possible to secure close pressure regulation by allowing efficiency of combustion to change with fuel feed.

It is also possible on stoker fired boilers to control the fuel manually and regulate the air automatically from steam pressure changes, varying efficiency as well as the rate of combustion. In fact, the boiler dampers can be opened and closed frequently and never assume an intermediate position corresponding to the load, with the result that a uniform steam pressure will be maintained with sacrifice of efficiency.

With oil and gas, as well as pulverized fuel, it is possible to control fuel by steam pressure, (and not the air at all) and to regulate pressure by varying not only the amount, but also efficiency of combustion.

Combustion Efficiency

It was assumed, however, that control of combustion efficiency, as well as control of steam pressure is desired. In fact, it should be given preference over pressure regulation. This being true, control of both fuel and air must be used. Pressure regulation may then be secured by regulating rate of combustion at the best possible efficiency.

The steam pressure controller may be one of two general types—proportional-position or proportional-plus floating (or reset). For boilers operating at fairly low pressures and having considerable water and steam storage capacity, a proportional-position type may be used. In this controller, movement of the power unit is directly proportional to change in pressure, (between lower and upper limits). The pressure change between the limits produces 100 per cent movement and is known as the proportional band. A narrow proportional band can be used and good pressure regulation obtained on boilers with high storage capacity.

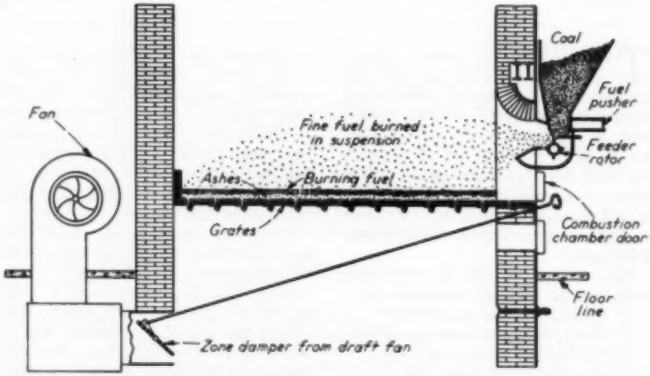


Fig. 2—Heat output for fuels, especially gas and oil, burned in suspension, can be easily and quickly varied to meet any fluctuating load demands on steam flow

The proportional-plus-floating master controller is used on high pressure boilers having relatively little storage capacity. This controller has proportional-position action which produces an immediate change in the position of the power unit, with an accompanying change in pressure. In addition, it has reset action which gradually applies an additional correction until the pressure has been returned to the set point. Use of this controller makes it possible to operate with a fairly wide proportional band to take care of sudden swings, while still retaining good pressure regulation.

Depending on nature of the load, steam pressure should be controlled to within about plus or minus 2 per cent of set point with proportional-position action and plus or minus 1 per cent with proportional-plus-floating action.

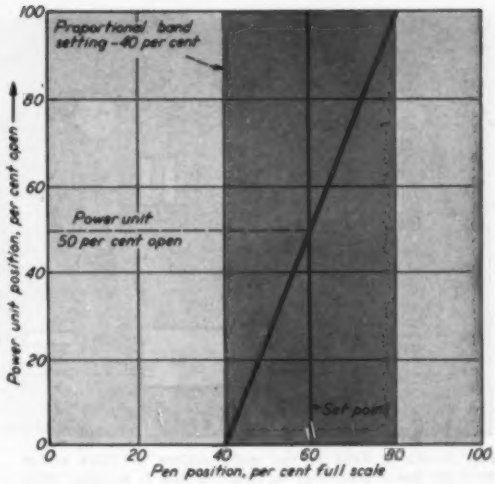


Fig. 4—With the proportional-position controller, power unit movement varies directly with changes in pressure within the proportional band. Reset action shifts the band, compensating for pressure drop required to cause pen movement

Why Steam Pressure Control?

All combustion control systems operate to maintain steam pressure within very close limits of a constant value, and steam pressure changes are always used to cause the control system to function. Yet why not use changes in steam flow for this purpose, since the steam flow is the load on the plant, and is the main purpose for which it is operated? Or why not use feed water flow since the water that is fed to the boilers is evaporated into steam and the flow of water might, therefore, indicate load on the boiler?

Steam flow is referred to as the load and if flow of water and steam increase, rate of combustion must also be increased to carry the load and maintain steam pressure constant. But this is not the complete story.

It is fundamental that "heat input must equal heat output, or steam pressure will vary".

Distribution of Heat Input

Heat input is heat from the fuel liberated in the furnace.

Heat output is this same energy converted or distributed into one of the following outlets:

1. Steam demand.
2. Loss in flue gas.
3. Heat added to feed water.
4. Loss to ash pit.
5. Loss by radiation.
6. Loss by convection.
7. Loss by conduction.

It is apparent that steam flow is not the entire heat output of the boiler. All energy does not go into the steam and flow of feed water does not reflect the entire load at any one time. So neither of these forces is suited to the responsible task of initiating combustion control movement.

Several of the heat output factors vary with time and therefore cannot be compensated for in an attempt to use either steam flow or feed water flow for control operation.

Variation of Heat Output

An analysis of the heat output indicates that any variation in quantity of heat distributed to any one of the outlets will affect steam pressure and that variation in pressure immediately indicates an unbalance between heat input and output. For instance, all other conditions remaining constant, steam pressure drops if steam load, flue gas temperature, feed water flow, or any of the losses increase. If the opposite changes in any one, or all, of these conditions takes place, the steam pressure rises.

These variables may or may not change in the same direction or in the same amount at the same time, therefore compensating action may or may not take place.

Instances have been experienced where, for some reason or other, feed water flow fluctuated so violently that the steam pressure variations were many times greater than would occur with the slight variations in the load at the time.

The action of these variables makes it impossible to use either steam flow alone or feed water flow as a means of operating combustion control. Since a constant pressure is desired and these variables definitely affect it, it is logical to operate combustion control from steam pressure changes.

Under certain conditions, a measurement of steam flow, in addition to pressure, may be used to finally establish proper air flow.

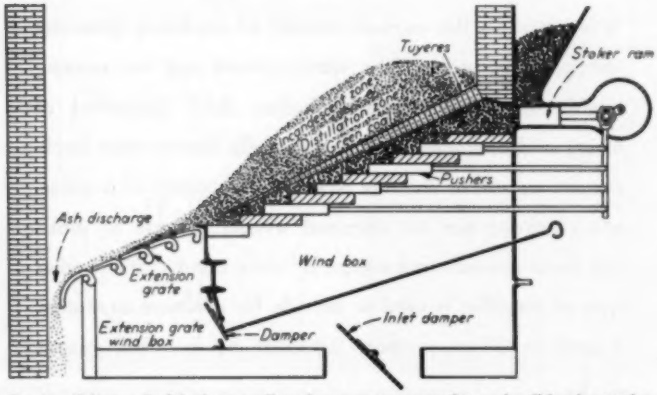


Fig. 3—A heavy fuel bed, as well as large water capacity and solid refractories, limits response to rapid load changes; is more satisfactory for steady demands

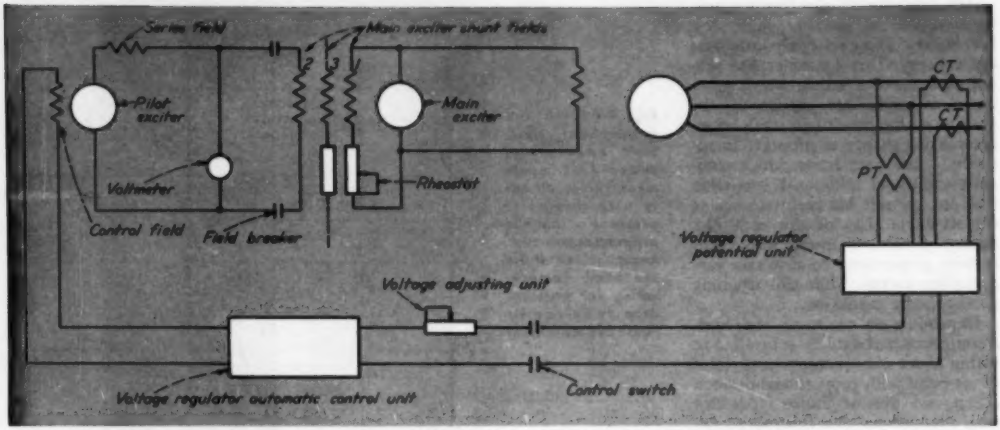


Fig. 1—No. 2 field of the main exciter provides either buck or boost excitation as required and is supplied from the pilot exciter, whose control field in turn is supplied from the amplifying static network of the voltage regulator automatic control unit. The potential unit at the right provides the positive sequence voltage signal for control

Static and Rotating Amplifiers Combine to Control Generator Voltage

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Many types and innumerable variations of amplifiers are used in industry. In this modern method of regulating generator voltage, three stages (one static network and two rotating types) control main field excitation. Brief discussions of theory and operation of each type help clarify other applications, as well as illustrate how sensitive control of a generator's voltage can be obtained without the use of make and break contacts and without a "dead band". Still another type of amplifier is used to provide for minimum excitation if load conditions promote instability by low field current

CHANGING REQUIREMENTS of power systems during the past ten years have brought about corresponding changes in specifications for turbine generator excitation systems. Extensive use of 3600 rpm generators with lower short-circuit ratios and centralized station control have increased the need for automatic voltage regulation.

Operation at higher power factor loading, because of the higher generator efficiencies and extensive system use of shunt capacitors, has resulted in smaller pull-out margins and placed more responsibility on the automatic voltage regulator to prevent instability. Also, need for greater reliability in system operation has increased the demand for greater reliability in the excitation system and a corresponding decrease in the outage time for maintenance of the automatic voltage regulator.

The rotating regulator excitation system for turbine generators has therefore been improved to provide automatic regulation with better reliability.

Formerly, standard turbine generator excitation equipment for automatic voltage control usually consisted of a main exciter with its field energized by a constant potential pilot exciter through a motor operated rheostat. A voltage regulator measured the small variations of the turbine generator a-c terminal voltage from a preset value and by means of contacts acted upon the motor operated rheostat in the main exciter field to either raise or lower the turbine generator output voltage back to its preset value. In addition, quick raise and quick lower contacts shorted or inserted resistance in the main exciter field for large variations

of the main generator terminal voltage.

This type of excitation system provides good, reliable automatic voltage regulation for most uses. However, for some applications, two characteristics are undesirable:

1. The voltage regulator has a "dead band" of a-c voltage through which the generator output can vary without initiating corrective regulator action.

2. In some applications, excessive maintenance is required for the regulator contacts which control the operation of the motor operated rheostat.

Rotating Regulator System

In the rotating equipment excitation system discussed here, the two disadvantages are eliminated by use of static networks for the voltage regulator, which is combined with the regulator pilot exciter. The static network type of voltage regulator has practically no "dead band" and, in addition, contact maintenance is eliminated because the network has no moving parts. This type of system also has flexibility in that other controls, such as a minimum excitation unit, can be added to increase effectiveness of the regulator in maintaining power system stability.

To better understand the excitation system, refer to Fig. 1 which shows circuit and equipment for a turbine generator unit using a buck-boost pilot exciter and a three field main exciter. In this system, the main exciter is a conventional self-excited shunt wound d-c machine with two additional windings called the control field and the stabilizing field. With the extra fields de-energized and the self-excited shunt field, *1*, under control of the field rheostat, the a-c main exciter behaves like any conventional self-excited shunt wound machine, and the output voltage of the main exciter is determined by the intersection of the shunt field resistance line and the saturation curve of the main exciter.

The main exciter control field, *2*, is energized by the pilot exciter. Depending upon the output of the pilot, this control field can either add to or subtract from the ampere turns supplied by the main exciter shunt field No. *1*.

In this manner, the main exciter output can be made to increase or decrease and thus control output voltage of the turbine generator.

The stabilizing field, *3*, is energized from a separate source, such as the station battery, through a fixed resistance. Use of this field in effect raises the saturation curve of the main exciter a slight amount so the shunt field resistance line has a definite point of intersection with the saturation curve. This is particularly desirable when adjusting the shunt field rheostat to obtain low output voltage from the main exciter on manual control, as when synchronizing the turbine generator with the system. By properly proportioning resistor and stabilizing field resistance, the current can be reduced to one or two amp. Thus the drain on the station battery is kept to a minimum.

Fail-Safe Feature

Use of a three field exciter has the advantage that in the event of failure of the pilot exciter or any of the voltage regulator components, the turbine generator still has a nominal amount of excitation, which is determined by the field rheostat in the self-excited shunt field of the main exciter. The rheostat is initially set so the main exciter can supply more than enough excitation for the generator to carry its normal load if control field ampere turns are lost.

Pilot Exciter Construction

The buck-boost pilot exciter is similar in design and appearance to a conventional d-c machine. Control and amplification are obtained through the use of several stator fields. Mechanical construction is essentially the same as any conventional machine of similar rating and speed. Physical size of a pilot exciter is substantially the same or slightly larger than conventional machines due to more field windings in the stator structure and operation with an unsaturated magnetic circuit.

The air gap is of normal size and the pilot exciter can be directly connected to the shaft of any generator operating at 1200, 1800 or 3600 rpm. In providing excitation for slower speed machines, such as hydroelectric generators and synchronous condensers, the unit must be separately driven to secure a smaller physical size which will not require excessive control energy.

In Fig. 1, it is evident that if the pilot exciter control field is deenergized, and the series field circuit is completed through the resistance of the control field on the main exciter by closing the field breaker, the pilot exciter is then equivalent to a self-excited machine, and its output voltage is determined by the intersection of the series field resistance line with the saturation curve. Resistance in the circuit consists of the pilot exciter series field resistance, the resistance of the control field on the main exciter, and a variable tuning resistance.

In Fig. 3, the saturation Curve *D* of

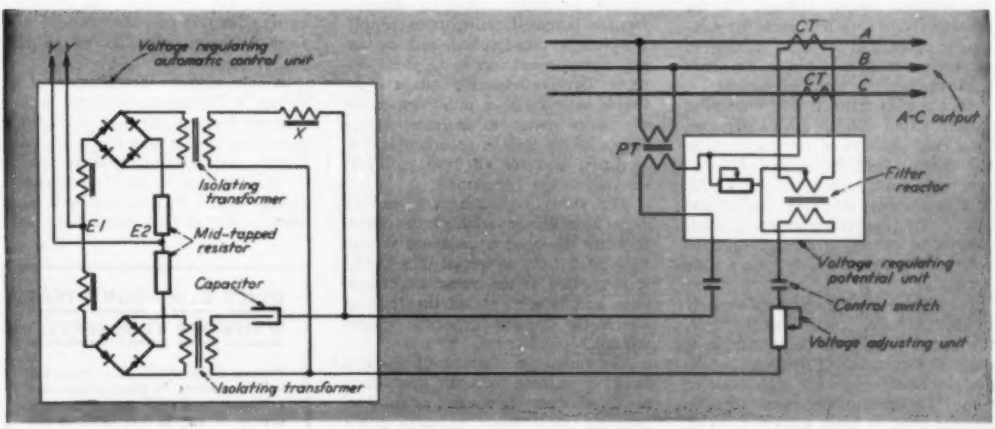
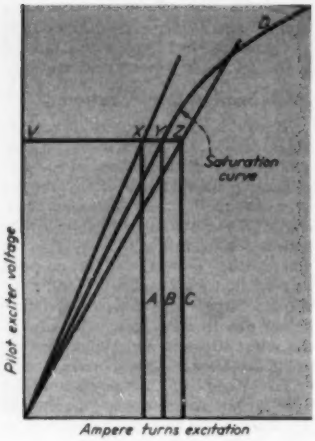
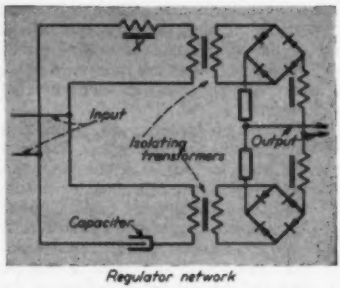


Fig. 2—Positive sequence voltage signal from network at upper right is made up of voltage and current components. Since the normal voltage, Fig. 4, of the regulator network is constant, the voltage adjusting unit determines terminal voltage by determining what fraction is matched against normal voltage. Regulator output feeds pilot control field





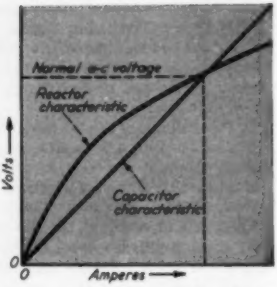


Fig. 4 (above)—The intersection of the non-linear and the linear impedance curves determines point at which d-c output is zero. Other output voltages provide positive or negative output to raise or lower the generator voltage as required

Fig. 3 (left)—Normal saturation curve of the pilot exciter may vary because of resistance changes. Regulator network output neutralizes these and other causes of voltage variation that affect the output and stability of the main generator

the pilot exciter is shown with several series field resistance lines. Normally the resistance line is adjusted to coincide with the straight portion of the saturation curve *OY*. However, due to temperature variations, resistance in the field circuit will change slightly, and the field resistance line may become *OX* or *OZ*.

If it is desired to maintain a given pilot exciter voltage, *V*, and if the series field resistance line is *OZ*, corresponding to excitation ampere turns at *C*, a small amount of negative ampere turns *BC* must be provided from the control field. This returns the excitation to point *Y* on the saturation curve to maintain the output voltage at *V*.

Likewise, if the series field resistance line is *OX*, a small amount of positive ampere turns *AB* must be provided from the control field to readjust excitation for constant output voltage. If the resistance line coincides with the saturation curve *D*, then no additional ampere turns are required, as the series field supplies the required amount.

In a similar manner, any other pilot exciter output voltage can be obtained by a small amount of ampere turns in the control field being added to or subtracted from those of the series field. In this manner, the pilot exciter acts as a rotating amplifier because a small amount of energy in the control field can vary the output energy over a wide range.

Fig. 3 shows only the positive half of the saturation curve *D*. However, the curve extends through zero in a negative direction and the output voltage can be reversed to a high negative value. This permits the pilot exciter to provide buck or boost ampere turns in the main exciter control field, which, when combined with the ampere turns of the main exciter shunt field, forming another stage of amplification, can control the turbine generator field and output voltage.

With the three field main exciter and pilot exciter as just described, a voltage regulator circuit is needed to complete the excitation system. The regulator, shown as boxes in Fig. 1, consists of three static networks:

1. Potential unit
2. Voltage adjusting unit
3. Automatic control unit

These units are shown in more detail in the diagram in Fig. 2.

Potential Network

The potential unit is a static impedance network consisting of a filter reactor, transformer and resistor so designed that the output is a single phase a-c voltage proportional to the positive sequence voltage at the terminals of the turbine generator. Input is obtained from a potential transformer supplying phase-to-phase voltage and two current transformers supplying phase currents. Positive sequence voltage is desirable as it gives an indication to the excitation system to increase voltage output of the turbine generator as load increases, and for all types of faults external to the generator.

The voltage adjusting unit can be either a resistor or variable transformer. It varies the positive sequence voltage signal from the potential unit before it is applied to the automatic control unit, and is used to set the level at which the turbine generator output voltage is regulated.

The automatic control unit is also a static impedance network containing mainly a saturating reactor, a capacitor, isolating transformers, rectifiers, and a center tapped resistor. The signal from the potential unit, (and voltage adjusting unit) is applied to its input terminals. Its output is a d-c current, either positive or negative, which is applied to the pilot exciter control field.

Automatic Control Network

To illustrate how the automatic control unit functions, Fig. 4 shows impedance characteristics of the saturating reactor and the capacitor. The reactor has a non-linear characteristic because it saturates as the applied voltage increases, permitting more current to flow through it. The capacitor has a linear impedance characteristic, and the current through it is directly proportional to the a-c voltage applied.

These two impedances are so designed that their characteristics cross at a normal a-c voltage. When this value is applied to the two impedances, equal currents flow through them. These currents are then rectified and one subtracted from the other. The difference current, in this case zero, would flow from the output terminals to the pilot exciter control field.

A voltage lower than the normal a-c voltage will cause more current to flow through the capacitor than through the saturating reactor and result in a difference current of one polarity flowing to the control field. Conversely, a voltage higher than normal will cause more current to flow through the satu-

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rating reactor than through the capacitor and result in a d-c current of opposite polarity flowing to the control field of the pilot exciter.

Combined Operation

Therefore, if the turbine generator positive sequence output voltage as obtained from the potential unit and voltage adjusting unit is equal to the normal a-c voltage on the automatic control unit characteristic impedance curves, the net d-c current output to the pilot control field is zero, and the output of the main exciter remains constant, producing no change in the turbine generator terminal voltage. But if the generator terminal voltage decreases, the positive sequence voltage applied to the automatic control unit decreases, causing more current to flow through the capacitor than the saturating reactor, and produces a net d-c output to the pilot exciter control field. Polarity and magnitude will be such as to cause the pilot output to increase the main exciter output and restore the generator voltage to the predetermined level.

In a similar manner, an increase in generator terminal voltage causes the automatic control unit to reverse its polarity, causing the pilot exciter to buck down the main exciter output, thus reducing the generator voltage to the normal value.

If a regulated terminal voltage of the turbine generator higher than normal is desired, the voltage adjusting unit resistance is increased. The automatic control unit "sees" a lower voltage than normal and its output to the pilot exciter is such that the terminal voltage of the turbine generator is increased and maintained at a higher level. Decreasing the resistance lowers the regulator voltage level at the terminals of the turbine generator.

The regulator just described, by making use of static impedances, eliminates contacts and moving parts used in earlier units. The static impedances have been so designed that standard potential and current transformers can supply enough energy to the regulator to produce ample output energy to control the pilot exciter. The amplifying characteristics and low input energy requirements have made this possible.

For small voltage changes at the turbine generator terminals, the static network type of voltage regulator initiates immediate corrective action. In fact, the pilot exciter is continually acting to maintain the generator terminal voltage. Generally, this cannot be permitted in the contact making type of voltage regulator, as it would result in excessive contact maintenance.

Minimum Excitation Unit

Another feature often incorporated is the minimum excitation unit. Fig. 5 shows the circuit and components for this device. Its purpose is to prevent the turbine generator field current being reduced to a value that would permit pull-out and instability. It is also a static network that requires practically no maintenance.

In operation, phase-to-phase voltage and phase currents from the turbine generator potential and current transformers are combined to produce a single phase a-c voltage proportional to kilowatts. This potential is applied to the a-c winding of a three-winding saturable reactor. The middle winding is energized from the d-c output voltage of the main exciter and normally saturates the reactor. This reduces the reactance of the a-c winding so that its low impedance permits very little of the a-c voltage to be impressed on the rectifier, limiting the d-c energy to the pilot exciter control field, *2*, added for use with the minimum excitation unit.

When the main exciter output voltage drops below a safe value determined by the kilowatt loading of the turbine generator, d-c current in the middle winding of the saturable reactor decreases, and the reactor becomes unsaturated, presenting a high impedance to the a-c voltage applied to it. The voltage applied to the rectifier and current in the control field, *2*, increase.

The field is connected so that it will increase the main exciter output voltage and thus increase the turbine generator excitation to a safe value for the kilowatt load it is carrying. This prevents the generator from pulling out of step with the system and prevents steady state instability. The minimum excitation unit is so designed that its output to control field, *2*, can overpower the output from the voltage regulator to control field, *1*. Therefore, even though the voltage regulator may be trying to reduce the turbine generator field current, the minimum excitation unit insures that it does not decrease below a safe value required to maintain steady state stability.

Characteristics of the minimum excitation unit can be varied to suit the stability requirements of turbine generator units connected to different systems. This is necessary in view of the fact that the pull-out characteristic of a turbine generator is a function of the reactance of the system to which it is connected.

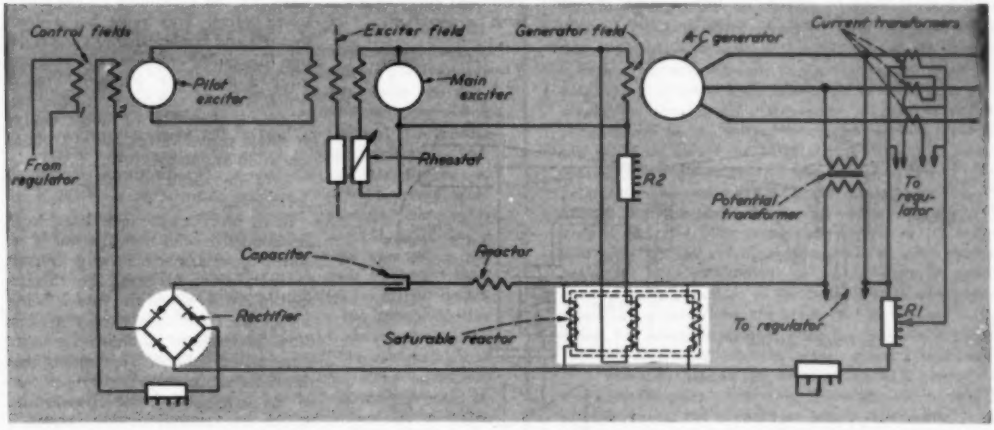
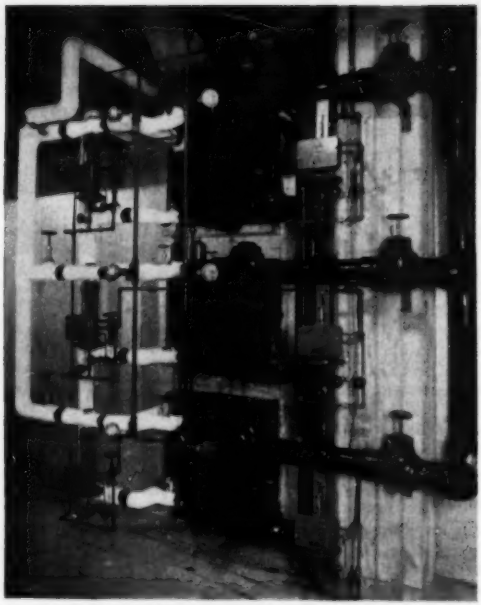


Fig. 5—Feedback from the generator field acts on the d-c coil of the saturable reactor to reduce its a-c impedance and prevent excitation of No. 2 control field. When generator excitation is too low for stability, reactor impedance increases and provides enough control field current to bring the main generator excitation back to a stable value



VALVE POSITIONERS

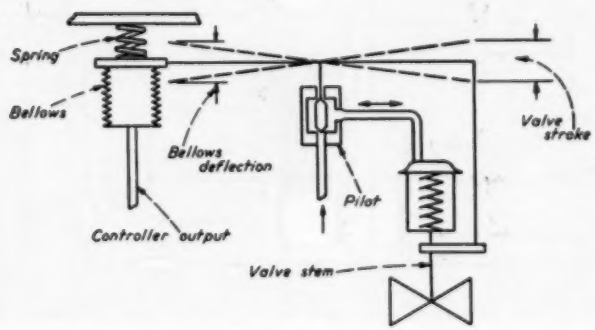
Pneumatic valve positioners automatically control flow of gases, steam and numerous other fluids. Underlying principles of these positioners are explained pictorially to aid plant engineers in obtaining the know-how to select these devices to solve the problems confronting them in the field

CHESTER S. BEARD, *Consultant*

Positioners on these valves regulate water flow to cooling and heating coils to hold ideal zone temperatures

PNEUMATIC CONTROLLERS have been refined to the point where producing an output pressure that varies with minute changes of the measured variable in an extremely precise manner is possible. To successfully employ this instrument for accurate control, however, necessitates comparable precision in positioning the device it operates. Thus if a controller is employed to maintain pressure on a steam line, the steam valve must assume the correct position as dictated by the controller to increase or retard the flow through the valve. Setting the valve is important if the success of a system is to be comparable to the precision of the controller. The pneumatic valve positioner accomplishes this operation when the air supply is tied into the diaphragm of the motorized valve or piston operator.

There are numerous conditions to be found in process systems that can be benefited by installing a valve positioner, but precise point at which the positioner becomes necessary is difficult to set. The following points are the most important conditions under which this instrument is to be specified.



In the proportional deflection balance system output, air positions a pilot so as to bleed diaphragm air. Valve stem deflects beam to establish an equilibrium

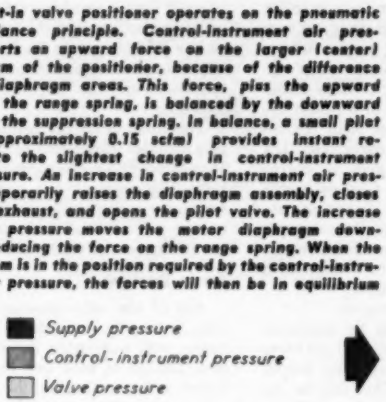
1. High pressure drop across valve.

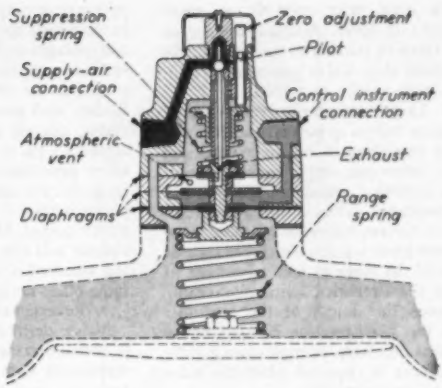
Increase in pressure drop decreases the stability of any valve. The advent of the balanced valve has eliminated a large amount of the affect, but even with this type, there is a point at which the normal available diaphragm area to spring weight ratio is not sufficient to set the valve at exactly the desired opening. This is particularly true as the unbalanced force reverses during the movement of the valve. Utilizing the valve positioner has made possible widening the usefulness of the single seated valve. This valve has a tight shut-off and is adaptable to venturi design that can be employed to advantage using a positioner. Pressure drop at which various companies feel a positioner is desirable, on either double or single seated valves, varies from as low as 60 to 250 psi.

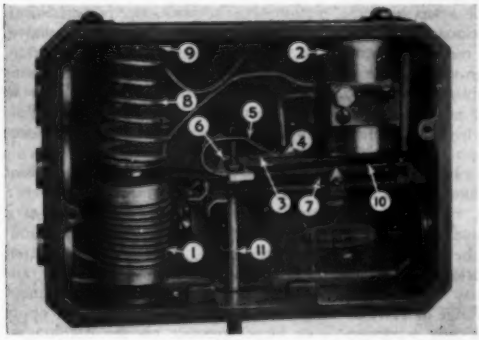
2. Wide throttling range control operations.

Many processes are such that a large deviation from the control point is required to make a small change in controlled medium. An example of this is a feed to a still. When the feed is being withdrawn from an accumulator, it is often advisable to minimize the entire accumulator volume. This means that throttling range may be 100 per cent of the length of the level controller on the accumulator. In other words, a change of level from an empty tank to a full tank is necessary to open fully the discharge valve. However, the

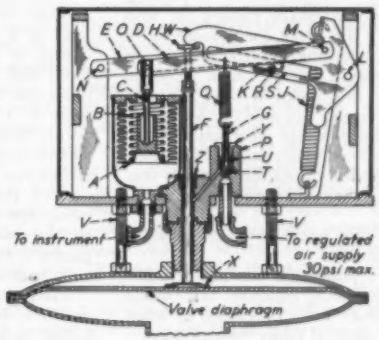
This built-in valve positioner operates on the pneumatic force-balance principle. Control-instrument air pressure exerts an upward force on the larger (center) diaphragm of the positioner, because of the difference in the diaphragm areas. This force, plus the upward force of the range spring, is balanced by the downward force of the suppression spring. In balance, a small pilot flow (approximately 0.15 scfm) provides instant response to the slightest change in control-instrument air pressure. An increase in control-instrument air pressure temporarily raises the diaphragm assembly, closes off the exhaust, and opens the pilot valve. The increase in valve pressure moves the motor diaphragm downward, reducing the force on the range spring. When the valve stem is in the position required by the control-instrument air pressure, the forces will then be in equilibrium







This positioner consists primarily of a metal bellows and a low-leak relay air valve. The bellows receives the output air pressure of the controlling instrument. The relay air valve controls an auxiliary 20 psi air supply, which inflates the diaphragm valve motor. Precision valve stem positioning is accomplished by two influences on the relay air valve. FIRST—the bellows (1) responds linearly to output air pressure changes from the controlling instrument. Bellows expansion or contraction actuates the relay air valve (2), (through frictionless levers), by changing the space relation between its baffle (3) and nozzle (4). A variation in this distance of 0.002 in. is sufficient to produce a full valve stroke. Used with any size diaphragm motor, positioner stability is accomplished by the adjustment of foot (5). SECOND—a rod (11) attachment to the ball-jointed take off on the stem of the valve, transmits valve stem movement to a lever (6) in the positioner case. This lever strikes an adjustable pivot (7) to further affect the space relation between relay air valve baffle and nozzle. Positioning action is therefore definitely linear. The relay air valve is first actuated by a change in controlling instrument output. Immediately thereafter it is further affected by valve stem movement or lack of movement, in which case any part of the full 20 psi positioner air supply becomes available for overcoming the friction and for positioning the valve exactly according to the demand



This valve positioner contains a spring loaded bellows (A) which assumes a definite position for any pressure transmitted by the air controller. Bellows movement rotates lever (D) around its pivot (M), thus raising or lowering the pilot valve stem (G) from its neutral position. When pilot valve stem is raised, air supply port (T) is uncovered, admitting air to the diaphragm. When lowered, the pilot valve stem allows air to escape from the diaphragm through (U). Movement of the valve diaphragm rotates the slotted lever (W) around pivot (L) and raises or lowers the adjustable pin (K). This rotates lever (E) around pivot (N) and raises or lowers pivot point (M). Movement of (M) again rotates lever (D) but around (O) as a pivot. As a result of the rotation of (D) around (O), the pilot valve stem returns to its neutral position with the valve diaphragm in a new position. When the pilot valve stem is moved from its neutral position by a movement of the bellows, it is subsequently returned to neutral by the movement of the diaphragm valve. For example: as controlled air pressure increases, the free end of the bellows moves upward and repositions point (O). Lever (D) rotates clockwise around (M) and lifts the pilot valve stem, admitting air to the diaphragm valve. The diaphragm moves downward, lowering rod (F) and rotating lever (W) counterclockwise. Resultant downward motion of (M) rotates lever clockwise around (O) and repositions the pilot valve stem

valve must react correctly to small changes in level. A small amount of hysteresis or friction in the valve might preclude this. Valve positioners facilitate more precise movement.

3. Large characterized port valves.

Many valves in process control have ports machined to obtain a particular curve when per cent of maximum port area is plotted against stem movement. Furthermore, valves with characteristics to fit the requirements of the control system have actually furthered precise control. In order to take advantage of these characteristics, a true relationship between the output of the controller and the stem position of the control valve is necessary. In most cases, a valve positioner is required when the valve is 4 in. or larger.

4. High pressure applications entailing tight packing.

Stems that stick require a valve positioner. Holding high pressure is very difficult with most forms of packing, without occasionally causing the stem to stick. This is not due so much to the types of packing available, but to the aggravated effect of slight misalignment in this design of valve requiring close tolerances in guiding. Valves are now available that incorporate design features to eliminate packing. However, their application has been mostly confined to other than high pressure installations.

5. Valves handling sludge or solids in suspension.

Valve positioners are also required when handling materials that would cause sticky stems or guides, or when 10 ply material flows through ports.

6. Nonstandard pressure requirement of valve or piston or nonstandard output from the controller.

One of the few conditions in process work that has been standardized by most instrument suppliers is the 3-15 psi range of output from the controller. In most cases the valve is designed with a diaphragm and spring to give full operation with this pressure range delivered to the diaphragm. Many installations, such as the use of a piston operator, operate on more than the accepted 15 psi to cause movement. The valve positioner may give an output range of, for example, 6-60 psi to the piston with a 3-15 psi change in controller output. Design of the valve positioner will also make possible furnishing standard 3-15 psi to a valve with some other range of output.

7. Reverse valve operation.

Valve positioner may be employed to obtain decreasing output to the valve diaphragm with an increasing output from the controller. This can be accomplished in most controllers, but systems may have one valve move from closed to open position while another moves from open to closed position.

8. Increase speed of operation.

Small volume of the operating bellows of a valve positioner reflects a change of controller output pressure much more rapidly than would occur if this output might be obliged to fill the space in a diaphragm topworks or a piston. When utilizing higher pressures with a springless operator, time of operation may be cut to as little as 20 per cent of that of a motor diaphragm valve. For this reason, the valve may be successfully operated at a much greater distance from the controller.

9. Split range operations.

Valve positioner may be adjusted readily to deliver full range of valve or piston loading through only a portion of the controller output range. This makes possible heating an exchanger with exhaust steam under normal loads. The positioner can be set to open the exhaust steam valve fully with a 9 psi output from the controller. A positioner on high pressure make-up steam would be set to start opening this valve at possibly 8 psi to augment the low pressure steam. Innumerable conditions of plant operation may be improved by this method.

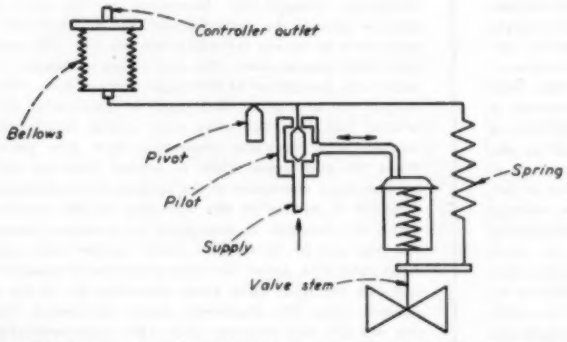
This listed group for positioner probably includes 95 per cent of the applications encountered in instrumentation design. The remaining 5 per cent are within the innumerable possibilities for unique and novel methods of utilizing the characteristics of the positioner.

Basic Designs

Any of the valve positioners, available from the instrument manufacturers, will accomplish the same function. Design of each one may be different, as they will reflect the individual talents of the instrument designer. The controlled air output of a pneumatic controller is brought into the positioner. For each output pressure, the diaphragm motor valve should assume a definite position. The positioner is mechanically connected to the stem of the valve. It may evaluate valve stem position, and consequently, the valve positions with relation to the controlled air to the positioner. A separate source of air is fed to the positioner that motivates the valve. The positioner enlists this air to locate the valve at exactly the point called for by the controller.

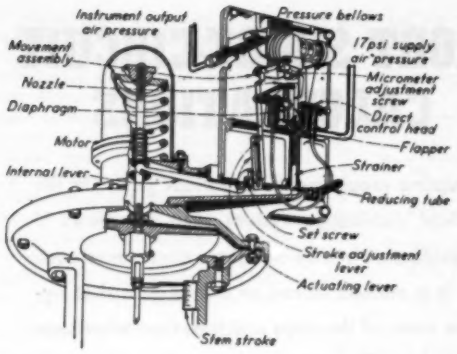
Two approaches to the design of a positioner have been taken by manufacturers. The proportional deflection balance system has the controller output air deflect a beam. This movement positions a pilot valve to either apply or bleed pressure on the diaphragm. The attendant movement of the valve stem deflects the opposite end of the beam. The design is such that deflection of the valve end of the cam is proportional to the bellows end when the valve is correctly positioned. Thus the pilot will open or close to create this equilibrium.

The second system employs a pneumatic force balance principle. In this design, the controller output pressure is applied to a bellows or diaphragm. Movement of the bellows operates a pilot, which supplies pressure to the diaphragm that positions the valve. Stem movement causes a spring to create a force to balance bellows effect. These forces are at equilibrium when the valve stem position is correct for the existing controller air output. These forces may consist of springs of different tensions and diaphragms of different diameters, thus eliminating linkages.

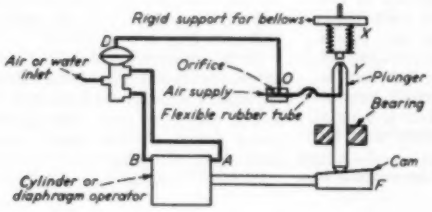


In this method, positioning is obtained by a pneumatic force balance system. Output pressure applied to bellows causes pilot movement to control stem pressure

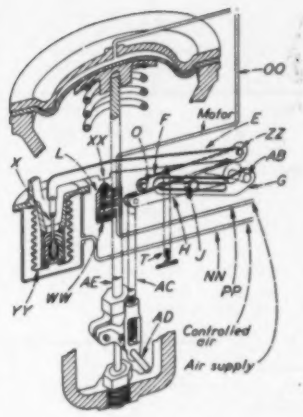
The second and concluding part of this article on valve positioners will appear in the May issue.



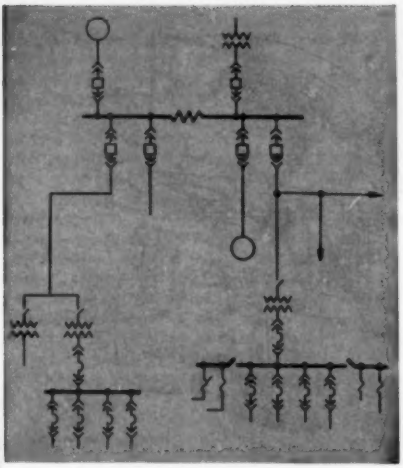
An increase in output air pressure will expand the positioner and push the movement assembly and the flapper to the right, uncovering a nozzle. This bleeds air from the control head diaphragm, seating the head so as to supply air to the motor. The motor air pressure will build up until the valve stem is sufficiently lowered to rotate the flapper back to a position of tangency just covering the nozzle. This rotation is accomplished through the mechanical linkage from the internal lever, the stroke adjustment lever, and the movement assembly. Hence for any given air pressure in the positioner, there is but one position of the valve stem, giving a positive relation between instrument output air pressure and valve position. For the slightest increase in output air pressure, full 17 psi air pressure is available on the motor to insure correct mechanical positioning of the stem



Either an increase or decrease of air from instrument changes makes bellows (X) move toward or away from nozzle (Y). This causes pressure to increase or decrease in air manifold (O) which causes a four-way pilot valve (D) to move from its midposition. In turn this applies pressure to one side or the other of the valve operator and moves the cam (F). Direction of movement depends on whether the instrument air pressure is increasing or decreasing. Movement of cam (F) causes plunger to move nozzle (Y), which in turn changes the pressure in valve manifold (O) enough to return the four-way pilot valve to midposition and equilibrium



In this system regulated air or noncorrosive gas (25 psi maximum pressure) is led through pipe (O) to pilot valve (B) which controls the flow through pipe (G) to the diaphragm of the control valve. The pilot valve is normally kept open by spring (E) and is closed by the movement of floating lever (K) acting on stem (A). The pilot valve is operated jointly by air pressure from the control instrument and movement of the control stem valve. Air from the control instrument coming to the spring loaded bellows (D) through pipe (P) gives a movement to the bellows that is in proportion to the pressure from the control instrument. This movement is transmitted through rod (C) to the left hand end of floating lever (K). The other end of lever (K) is pivoted at (L) to lever (J) which rotates about stud (H) as an axis. Lever (J) is rotated by a bell crank with axis at (M), in which arm (R) is rotated by the movement of the control valve stem acting through pin (U) and connecting rod (T), and arm (N) transmits the movement to lever (J) through pin (Q). Arm (N) has a slotted adjustment for changing the position of pin (Q), and thereby adjusting the movement of lever (K) relative to the travel of the valve stem (F). This adjustment will handle control valve stem travels from 1/8 in. to 3 in. Spring (S) holds lever (J) against pin (Q) and also takes up the backlash in the system of levers. In the illustration, pilot valve (B) is shown in a throttling position, and the control valve is in a halfway open position corresponding to an air pressure of 7 psi on bellows (D). The system is in a state of equilibrium with the air escaping through the exhaust port and ground stem (A) as fast as it enters through the inlet port of the pilot valve. Assume now that the pressure of the air from the control instrument increases to 10 psi. This increase in pressure will compress bellows (D) and move the left hand end of lever (K) upward, thereby opening the pilot valve wider and increasing the pressure on the diaphragm that will cause the valve stem to move downward carrying the right hand end of lever (K) downward in a movement tending to close the pilot valve. This movement continues until equilibrium is again established with the pilot valve still in throttling position but with the valve stem of the control valve in a position in direct correspondence with the air pressure from the controller acting on bellows (D)



SHORT SHORT-CIRCUIT CALCULATIONS

Interrupting requirements at various points in the electrical distribution system must be known if fault protection is to be adequate at minimum cost. Here is a method based on admittance that bypasses many of the steps and transformations usually involved. The calculations use the values and units normally supplied for equipment ratings

A. B. WHITE, *Associate Editor*

ABILITY OF CIRCUIT breakers and fuses to interrupt overloads and protect themselves, the cables and the utilization equipment, is well understood. In the past, where relatively simple systems were the rule and fairly high voltage drops were tolerated, fault currents were often not excessive and interrupting ability of equipment could often be taken for granted.

At present, however, greatly increased capacity and the modern high voltage distribution system with its excellent regulation can produce exceedingly destructive values of short-circuit currents. Breakers and fuses must be able to interrupt them safely and, along with switches, cutouts and cables, must be able to withstand the high magnetic forces of attraction or repulsion that occur between adjacent current carrying components.

Underrated equipment, although operating to interrupt fault currents, may not clear the affected lines because it fails either electrically or mechanically and may extend the damage by destroying itself or by creating new faults. Overrated equipment, of course, is unnecessarily expensive.

Probably one of the most important factors, however, is the fact that the load center system and subdivision of transformer capacity allow control of short-circuit impedance while maintaining good voltage regulation. The distribution system can be engineered for optimum performance at minimum cost when fault currents can be calculated and controlled.

Calculation Short Cut

Complexity of distribution systems, with multiple sources of supply, multiple feeders and contributions by motors have inspired several short cuts in making calculations. In the special survey, "Packaged Electrical Distribution Equipment" in the February issue, one method was briefly presented in example form. Here is a more complete explanation along with derivation of the formula.

Chief advantage of the method is that equipment rating values, as given on nameplate or tables, may be substituted directly in a simple formula. Answers are given in the same units employed in breaker application tables. Reduction of values to a common, and often confusing, kva base or to equivalent values is unnecessary.

Derivation of Method

In the derivation of the formula, as in the application, each source of power, or group of sources, is considered as a simple supply with unlimited capacity with an external (but inseparable) lumped impedance. The sources may be represented as generators, but are more commonly, especially where a group is involved, pictured as an infinite bus, Fig. 1.

If the output terminals of the source are short-circuited, Fig. 2, the inherent impedance, x, limits the amount of current I, which can flow. The apparent power output of the source under short-circuit conditions is:

$$VI/1000 = \text{kva}$$

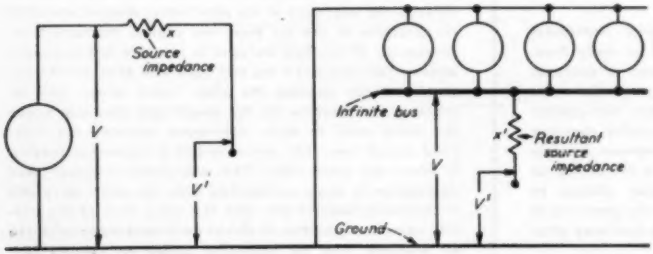


Fig. 1—In all short-circuit calculations, the source is usually considered as having infinite capacity, but with series impedance which limits current output

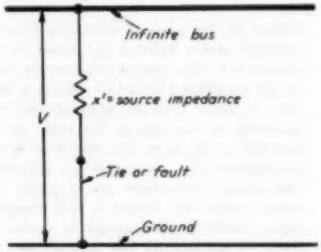


Fig. 2—Interrupting duty for source equals kva drawn by its own impedance

This is often called the power delivered to the fault; erroneously so because the voltage across a short circuit may be considered zero. It is, however, power delivered to the source impedance as well as that interrupted by a breaker or fuse; and is often given as the kva capacity of the source. Voltage of the source determines length and intensity of the arc during interruption. As voltage increases, current must correspondingly decrease, which is the reason high-voltage breakers are normally rated (within given voltage limits) in kva interrupting capacity.

Kva Capacity of Impedance

Transformers and feeders (and current limiting impedances) used in the distribution system have impedance which may also be considered as individual lumped values. They will be in series with the source impedance and will further limit the current when a fault occurs on the load side, Fig. 3; and the interrupting rating for equipment will be determined by the corresponding kva possible at the point of fault.

The source impedance is normally expressed as kva short-circuit capacity rather than as its ohmic value. The transformer or feeder impedance can also be expressed as kva capacity and combined directly with it as follows:

In Fig. 4, current which could be supplied by a short circuit directly on the source is:

$$a' = V/x'$$

Therefore, the source impedance, x', expressed in terms of voltage, V, and the maximum short-circuited current, a', possible from the source is:

$$x' = V/a'$$

Similarly, if the transformer, (or feeder) with impedance x'' were connected between the *same infinite bus and ground*, the current a'' would flow at the load terminals and x'' might be expressed as:

$$x'' = V/a''$$

Where the fault is on the load side of impedance x'', both impedances are in series and the current, a, is limited by the sum of their ohmic values, or:

$$a = \frac{V}{x' + x''}$$

$$= \frac{V}{V/a' + V/a''}$$

$$= \frac{1}{1/a' + 1/a''}$$

$$= \frac{a'\,a''}{a' + a''}$$

Also:

$$a = \frac{(Va') \times (Va'')}{V\,(Va') + (Va'')}$$

or

$$va = \frac{va' \times va''}{va' + va''} \qquad \text{(formula 1)}$$

This is the basic formula used in the method. The va values can be equally well expressed in kva on mva as long as the same units are used throughout.

The impedance, x'', of the circuit component is now expressed in terms of the kva, or apparent power, it would carry if it were connected between the infinite bus and ground. Values usually given, as for transformers, are in per cent impedance which is per cent voltage drop at rated capacity for an inductive load when the *primary* is connected between an infinite bus and ground. Therefore, the short-circuit (s-c) capacity at the secondary terminals is:

$$kva'' = \frac{\text{rated kva} \times 100}{\text{per cent impedance}}$$

which for a transformer with 5 per cent impedance would be 20 times its rated kva.

The short-circuit capacities of the combined impedances, besides determining the interrupting duty of breakers at that point, can now be used with the value for the next impedance in series. Note that:

1. The formula does not involve voltage. In calculating interrupting duty on the secondary side of a transformer, only short-circuit capacities of source and transformer need be considered.
2. Values are not changed to a common base.
3. Interrupting duty is determined at each successive point.
4. Once the interrupting duty for a given point is known, that point may be considered the source for the next impedance, or series of impedances, toward the load. This will often avoid network calculations at the end of branch circuits.

Paralleled Sources

The preceding discussion considered a simple straight line series circuit. Where two or more sources are paralleled, each will have its own inherent impedance but normally will deliver current to the common bus, Fig. 6. If the common bus were faulted, as through breaker *a* to the ground, each would deliver its individual short-circuit current, or kva capacity, limited

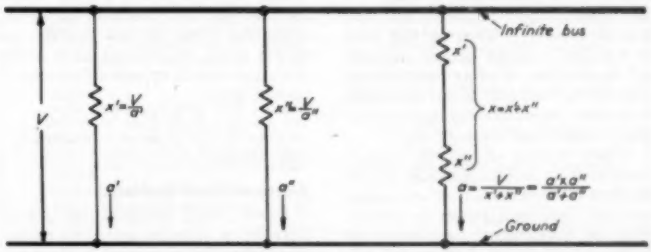


Fig. 4—For a given voltage, impedances may be expressed in terms of current, and the current of two in series expressed by a combination of the same units

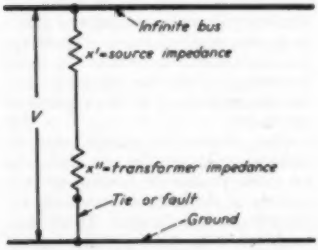
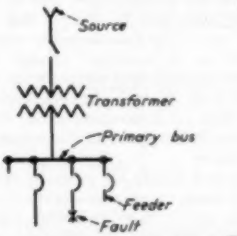


Fig. 3—Interrupting duty is reduced by impedance in series with the source



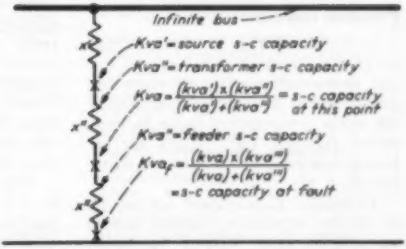


Fig. 5—Simple radial circuits may be represented by impedances expressed in kva units. Interrupting duty at any point becomes source capacity for next step

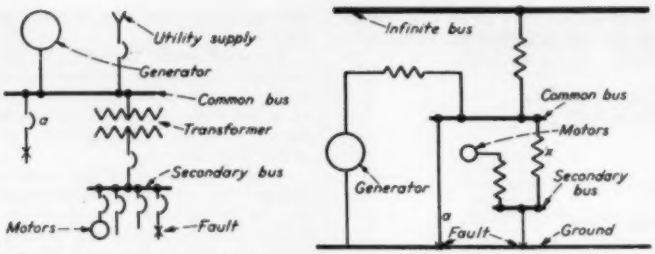


Fig. 6—Short-circuit capacities of parallel sources add and the total becomes interrupting duty at common bus, as well as source capacity for series impedance

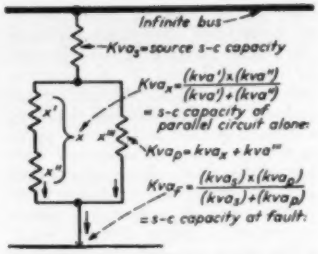

Infinite bus
Kva$_s$ = source s-c capacity
Kva$_x$ = (kva')x(kva'') / (kva')+(kva'')
= s-c capacity of parallel circuit alone
Kva$_p$ = kva$_x$ + kva'''
Kva$_f$ = (kva$_s$)x(kva$_p$) / (kva$_s$)+(kva$_p$)
= s-c capacity at fault

Fig. 7—Parallel impedances are handled like parallel sources in inverse order

only by its own impedance, to the fault. The total, of course, would be the sum of the capacities of all individual sources.

However, if the common bus were not faulted directly through path *a*, but through impedance *x*, which might be a transformer, the kva capacity delivered by each source would be reduced more by the impedance than if either source alone were involved. However, all sources are connected to the common bus, and kva output of each is reduced proportionately by the voltage drop in impedance *x;* and it can be shown that the common bus may be considered the source for any equipment beyond it.

Therefore, to find the interrupting duty of breaker *a* in the left hand line drawing of Fig. 6, add the short-circuit capacities of both sources (which will have been already calculated for their own tie breakers). Then use this value in equation 1 as the source capacity, *va'* or *kva'*, in finding interrupting duty on the load side of the transformer or other impedance having the maximum short-circuit capacity, *kva''*.

Where sources of power, such as generators or motors (which at the moment of short circuit, act as generators and feed back power in parallel with the transformer), are connected to the secondary bus, it is treated in a manner similar to that for the common bus. Contributions from all sources are added to find the *total* interrupting duty of any breakers or fuses involved.

Parallel Impedances

Inspection of Fig. 7 will show that circuit is substantially the same as the one at the right in Fig. 6, where the generator and the infinite bus, operating at the same voltage might be connected together. The circuits are inverted, however, which does not affect results.

Therefore short-circuit capacity of each impedance (taken across an infinite bus) would be calculated as before. Capacities of series impedances such as x' and x'' would be combined by means of equation 1 and the resultant capacity for the circuit added to those in parallel with it. This is the total kva capacity of the parallel circuit when connected directly to the infinite bus, or unlimited source. Where the source has appreciable impedance, as heretofore assumed, equation 1 will again be used as before to find the actual interrupting duty.

An example on parallel impedances is given in the calculations for a loop circuit in the box on page 85.

In low voltage utilization circuits, breaker and fuse ratings are normally expressed in amperes and application tables (page 92, February issue) are available which give transformer short-circuit currents and motor contributions in the same units. The tables can be used directly in the selection of secondary breakers where simple radial circuits only are involved. However, where the tables are not available or do not apply, the equation form in the derivation which appeared in terms of current only:

$$a = \frac{a' \times a''}{a' + a''} \qquad \text{(formula 2)}$$

may be used.

Asymmetrical Ratings

Power circuit breakers, for use at distribution voltages, carry two ratings which must be considered in short-circuit calculations. Ability of the unit to interrupt current is based on symmetrical values of current or kva. However, because a short circuit may start at any point of the voltage wave, axis of the current wave may be shifted momentarily and cause peak currents which exceed the symmetrical values. Although the transients normally die out before 5 or 8 cycle power breakers open, they are important because magnetic forces increase with the square of the current.

The peak values are generally taken as 1.6 times maximum symmetrical current, and breakers and other equipment are designed to withstand the maximum mechanical forces based on that figure. Thus the momentary current rating is 1.6 times the interrupting rating.

Low voltage breakers are designed for instantaneous operation and interrupting duty is the same as the momentary rating. However, higher resistance in utilization circuits cause transients to die out rapidly and the factor for asymmetrical currents is normally taken as 1.25. In the calculations, either symmetrical values must be used throughout and the factor introduced into the answer for interrupting duty, or all current and kva values used in the calculations must be asymmetrical.

Feeder Resistance

Impedance in the source, motors, transformers and most other distribution equipment is primarily reactive in nature and generally considered as such in short-circuit and voltage drop calculations. Consequently, they can be combined arithmetically without appreciable error. This is also true of most high voltage feeder cables found in industrial plants; but there may be appreciable error for feeders composed of spaced wires.

In low voltage utilization feeders, however, cable resistance may have an important effect in reducing short-circuit currents, and often allows the use of much smaller breakers or fuses at the ends of long feeders and tie cables.

For an accurate solution, resistance and reactance must be combined vectorially, or by the use of calculating boards. However, it can be shown empirically that where resistance of cables is greater than reactance, a good approximation may be obtained by using the average of the two values to calculate the short-circuit or kva capacity of the feeder.

Thus, if per cent reactance and resistance are known for the cable, use the *average* value in finding the kva capacity of the cable as previously explained for transformers. This value, combined with the substation short-circuit capacity in formula 1 gives the interrupting duty at the cable end.

Or where ohmic values of resistance and reactance are known, divide the square of the circuit voltage by the *average* value and by 1000 to obtain the kva short-circuit capacity for use in formula 1.

Where only impedance of the cable, either in per cent or ohmic values, is known, two-thirds of the value may be used as above in place of the average. Either method has about the same accuracy, although the average gives results on the high or safe side; the two-thirds value, on the low side.

Errors in using the approximations generally will be quite low, less than one per cent for the tie cables in the following example where short-circuit capacity of the cable itself is considerably greater than that of its source (the substation). Error increases to about five per cent as source and cable capacities become equal, which would normally mean only the smallest breakers were involved.

Example Calculations

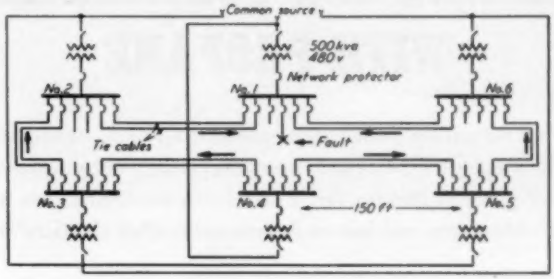
The example in the box is reprinted from page 93 of the February issue and illustrates many of the principles discussed. Note that parallel circuits formed by each substation were first combined as though they were connected to an infinite bus; and that finally the result was combined with the short-circuit capacity of the source, which is common to all.

Short-circuit capacities for the substations (considered as being connected to an unlimited source) were taken from application tables for the example. The 500 kva transformers have 5 per cent impedance. Their short-circuit capacity calculated, as previously explained from the 602 amp full load current, is 12,040 amp times the 1.25 asymmetrical factor or 15,000 amp. Induction motor connected kva is assumed equal to transformer capacity and the short-circuit contributions as five times full load current, or 3000 amp; making a total short-circuit capacity of 18,100 amp or 18.1 ka.

Amperes, or kiloamperes, were used as units because most low voltage equipment is so rated. Kva units could be equally well used.

The kva method of computing short-circuit values to find interrupting duty required of breakers and fuses has been discussed in detail in order to establish a working background. It will be recognized that once conditions are visualized, actual calculations are quite brief and simple, especially when starting at an intermediate point of known interrupting capacity.

Although theoretically correct, the method will probably be found most useful in supplementing the more familiar network calculations.



FAULT CURRENTS IN LOOP OR TIE CIRCUITS

Currents as in Table 13 are proportional to kva (or mva). For a given voltage, formula (1),

$$mva = \frac{(mva)' \times (mva)''}{(mva)' + (mva)''}$$

can be stated

$$a = \frac{a' \times a''}{a' + a''} \text{ (formula 2)}$$

Where

a' = short-circuit current of a source for zero impedance fault (such as the combined currents, Table 13)

a'' = short-circuit currents that could be delivered by an impedance (such as the tie cable) alone if it were connected to an infinite bus at the same voltage, or

$$= \frac{\text{full load amp} \times 100}{\text{per cent impedance}}$$

a = value to which a' would be reduced by flowing through the impedance used in finding a''.

Kiloamperes may be used for convenience without affecting results. However, the factor, 1.25, for d-c component must be included in all currents, or excluded from all until the result is obtained.

EXAMPLE

In the diagram, six 500 kva, 480 v substations spaced about 150 ft apart are connected by a secondary loop. Tie cable reactance is taken as 0.7% on the same base, 500 kva, as the transformers. Utility capacity is 100 mva.

Full load current from Table 13 is 600 amp, or 0.6 ka, symmetrical, and does not include the 1.25 factor for d-c. Then

$$a'' = \frac{0.6 \times 100}{0.70} \times 1.25 = 107 \text{ ka}$$

This is the asymmetrical current that would flow if the cable were connected to a 480 v bus of infinite capacity. It is assumed to be constant for all tie cables in this example.

Since there are an even number of substations, the contribution of the one farthest from the fault will divide and flow down both sides of the loop. Therefore the original source is divided in Step 1:

STEP 1:

From Table 13, combined asymmetrical short-circuit current for substation is 18.1 ka for infinite source capacity and

$$a_1' = \frac{18.1}{2} = 9.0 \text{ ka}$$

Applying formula 2,

$$a_1 = \frac{9 \times 107}{9 + 107} = 8.3 \text{ ka}$$

This would be the contribution of one-half of No. 4 to a fault at No. 3, and combines with the capacity of No. 3 to become a' for the next step, or

$$a_2' = 8.3 + 18.1 = 26.4 \text{ ka}$$

STEP 2:

Again applying formula 2

$$a_2 = \frac{26.4 \times 107}{26.4 + 107} = 21.2 \text{ ka}$$

Similarly at center No. 2,

$$a_3 = 21.2 + 18.1 = 39.3 \text{ ka}$$

which again would be the fault current due to centers 2, 3 and 4 alone (for infinite source capacity) through a solid ground at No. 2. Since the actual ground is at No. 1, the value will be reduced as before by the final tie cable:

STEP 3:

$$a_3 = \frac{39.3 \times 107}{39.3 + 107} = 29 \text{ ka}$$

This is the fault current contribution for one side of the loop. The total for both sides and No. 1 substation itself is

$$29 + 29 + 18.1 = 76.1 \text{ ka}$$

This is the fault current for an unlimited source capacity, and must be calculated as such because the actual source impedance is *in series with* all substations involved.

The short-circuit current (on a 480 v base) which could be delivered by the source through zero impedance is

$$\frac{100 \text{ mva} \times 1000}{1.73 \times 480} \times 1.25 = 150 \text{ ka}$$

Finally, using formula 2 again to account for the source impedance,

STEP 4:

$$a = \frac{76.1 \times 150}{76.1 + 150} = 51 \text{ ka}$$

This is the actual fault current and compares to a value of 50,000 asymmetrical amp for the same example calculated by the network method.

The average tie cable reactance is usually sufficiently accurate. However, other values, including other impedances, can be substituted as necessary at the proper points.

UNEVEN NUMBERS OF SUBSTATIONS

Where an uneven number of load centers are connected in the loop, full short-circuit current capacity would be used for the center farthest from the fault. Other steps would be included as necessary.

TWO PARALLELED SUBSTATIONS

For two centers normally connected by a tie cable, only Step 1, using full capacity of the unfaulted center, and Step 4 are necessary. Step 4 could be eliminated without great error if the short-circuit capacities from Table 13 are based on source capacity (16.7 ka for the conditions of the example).

MEETING GAS CURTAILMENT WITH PROPANE

When natural gas consumption must be reduced due to excessive load demands, Oneida Ltd. maintains production by converting to LP gas. This standby fuel is completely interchangeable with the natural gas and has equivalent combustion characteristics

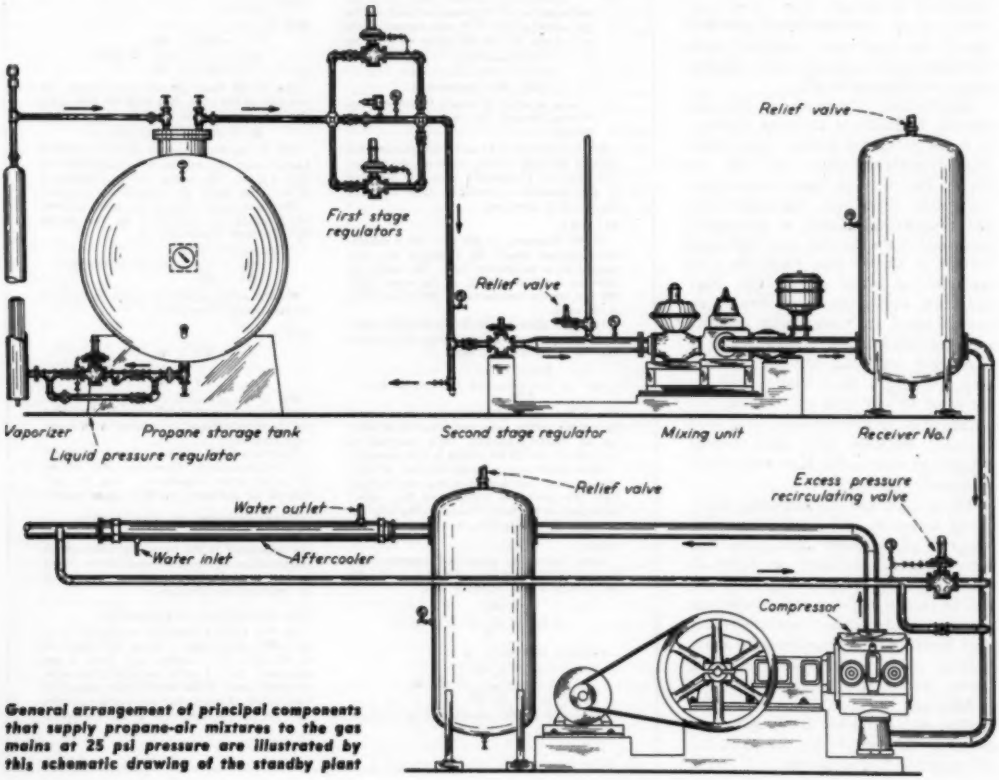
WALTER E. MOULTON, *Chief Metallurgist*
Oneida Ltd.

DURING October of 1950, Oneida Ltd., makers of the world famous brands of Heirloom Sterling and Community and 1881 Rogers silver plate tableware, converted their multiple heat process equipment to natural gas. This change, like many more industrial heat application conversions, was made so that the company could utilize the premium heat qualities and low thermal cost of natural gas for manufacturing operations.

While Oneida Ltd. had for many years been a satisfied user of manufactured gas, the coming of natural gas was to be of great importance. Their experience in changing to low cost natural gas compares favorably with results obtained by numerous other companies that have converted in the past. Similar performance will be shared by additional companies when natural gas transmission lines are extended to include other new areas.

Although great quantities of natural gas are available at their source, delivery to the ultimate consumer depends on long transmission lines. While supply to industry can be maintained most of the time, during short periods of the year demand for the gas may exceed the capacity of the pipe lines. For such emergencies, many industries install standby fuel systems to provide assurance that production can be continued without interruption.

When officials of Oneida Ltd. were advised that their supply would be converted from manufactured to natural gas, they realized standby fuel facilities should be obtained. Since production equipment employed gas, they felt that the substitute fuel should have similar characteristics and quality to prevent disruption of their manufacturing operations. After consultation with the local gas company, a decision was made to employ propane-



General arrangement of principal components that supply propane-air mixtures to the gas mains at 25 psi pressure are illustrated by this schematic drawing of the standby plant

air gas for the alternate fuel system.

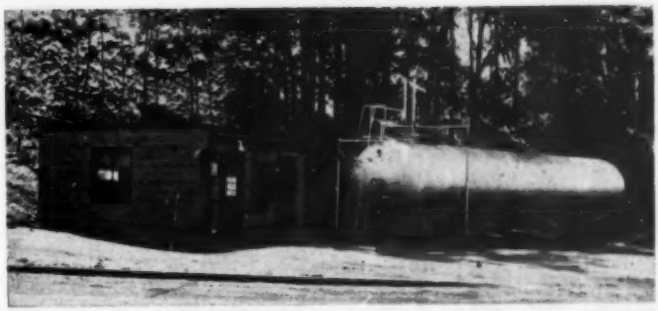
Propane-air gas, while equal in purity and uniformity, also has the distinct advantage of being 100 per cent interchangeable with natural gas. The Btu content of the propane-air gas can be adjusted to make it almost identical with natural gas in combustion characteristics. This permits operation with only a nominal, if any, change in burner adjustment even when propane-air gas replaces the natural gas completely.

Most curtailments do not involve 100 per cent of the natural gas supply. Since propane-air gas can be mixed with the natural gas in any proportion desired, it provides full replacement for all shortage conditions. This means 25, 50, 75 or even 100 per cent curtailment in natural gas supply can be readily compensated by adding whatever quantity of propane-air gas the load demands. Although many installations are arranged for combining supply sources, it is not necessary to mix the gases for utilization. Some systems are arranged so that best results can be obtained by serving one department of the plant with 100 per cent propane-air gas while the remaining part operates on 100 per cent natural gas. This arrangement also provides satisfactory service.

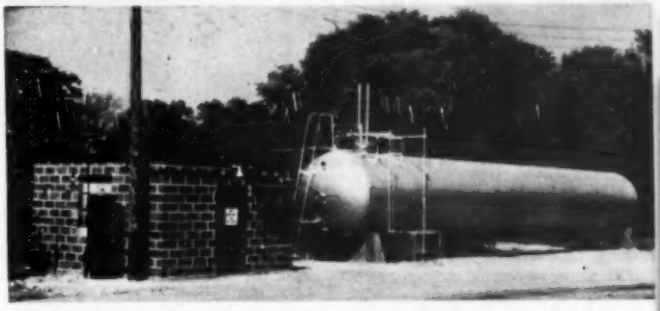
On recommendation of the local gas company, Oneida Ltd. retained a consulting engineer to design a propane-air gas system for each of their two manufacturing plants. One plant at Sherrill, N. Y. produces hollow ware and tableware, while the other a mile away, makes knives. Each gas plant consists of a 30,000 gal (water capacity) liquid propane storage tank and necessary vaporizing, mixing, and compressing equipment to deliver propane-air mixtures into the company mains at 25 psi pressure.

Several departments at the Sherrill plant are served individually by a plant distribution system. The propane-air gas was piped to every department where gas is used in appreciable amounts and connected at each main natural gas inlet. With this piping system it is possible to supply propane-air gas singly or collectively to any operation so connected. In addition, mixtures of propane-air gas and natural gas can be provided for all departments simultaneously, or any one department can function on 100 per cent propane-air gas while the remaining departments are operating with 100 per cent natural gas or a mixture of the two gases. This system offers the most flexible arrangement possible.

Of all gas utilized by Oneida Ltd., the greatest percentage is used at the Sherrill plant in a department having a number of 24 in. muffle type conveyer



Exterior photos of the two LP gas plants installed at Oneida Ltd. show marked similarity in relative locations of tanks and equipment



Liquid propane, stored in 30,000 gal tanks, is vaporized and mixed with air to provide fuel having the same Btu content as natural gas

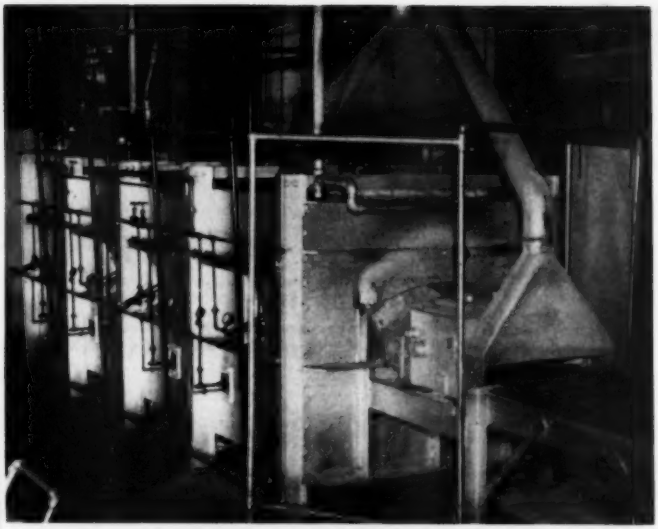
furnaces. The loading zone of these furnaces is heated by seven high pressure burners on each side, and regulated by an automatic temperature control instrument. Five burners of the same type on each side heat the rear zone and are similarly controlled.

The nickel silver product, in normal times, is about 18 per cent nickel, 64 per cent copper and 18 per cent zinc. This product is annealed in the muffle type furnaces during various stages of manufacture. Temperatures are controlled between 1050 and 1400 F, depending on the nature of the work. The annealing takes place in a protective atmosphere to prevent oxidation and discoloration of the nickel silver pieces. This protective atmosphere is produced by partially burning gas in a combustion chamber in the presence of a catalyst brick. With propane, the ratio approximates 18 parts of air to one part of propane and results in a gas consisting of 6 to 8 per cent carbon dioxide and hydrogen, 6 to 8 per cent carbon monoxide and the balance, nitrogen.

In the manufacture of nickel silver hollow handles, the handles are made in two halves, which are silver soldered together in electric furnaces. A reducing gas is employed to produce a protective atmosphere similar to the procedure described for the annealing operations. Since the silver solder must travel quite a distance by capillary attraction to close the seam of a hollow handle, good protection by a proper atmosphere is an absolute necessity.

Some handles are joined to the knife blades with lead-tin solder. The furnace for this operation employs standard high pressure gas burners. After assembly in the furnace, the edge of the lead-tin solder is remelted with a gas torch and wiped to obtain a very smooth, good looking joint. This operation requires skilled operators using carefully adjusted gas torches. The torch flame must be hot, but confined to a very sharp point to prevent remelting of the main joint. This operation is one of the most critical from the standpoint of changing from normal gas supply to standby gas.

The company has other operations that require the use of gas. Pot type furnaces are employed to melt the lead alloys that form the necessary castings for handles, spouts, feet and ornamentation of hollow ware pieces. The



Muffle type conveyer furnaces employed for annealing spoon stock were first production units to be operated by the standby fuel system

manufacture of stainless steel knives and blades utilizes gas heating for forging, heat treating and annealing.

The above resume of the equipment layout at Oneida Ltd. shows emphatically the need for standby fuel service during periods of natural gas curtailment. The propane-air gas system that serves the Sherrill plant was completed in January of 1951. Propane liquid for initial operation was delivered and unloaded into the storage tank. However, the Sherrill plant was shut down for annual inventory at the time, and the standby fuel system could not be started up and adjusted under normal operating conditions.

Oneida Ltd. had planned to start regular production at the Sherrill plant at 7 AM on Feb. 1. Due to an unprecedented cold wave, the company was notified to curtail their natural gas usage by 50 per cent when operations were resumed. Notification of the curtailment, which applied to both plants, was received on Jan. 31, before the new propane-air gas plant had been adjusted. Neither had a supply of propane been received at the knife plant in Oneida. For this reason full curtailment for both plants had to be absorbed at the Sherrill plant. As the greatest gas usage was at the 24 in. muffle type conveyer furnaces, it was decided to utilize 100 per cent propane-air gas in that department in order to reduce the natural gas consumption by the required amount.

After the preliminary adjustments, the propane-air gas was turned into the pipe lines serving the annealing furnaces. At approximately 3 AM of Feb. 1, the equipment burners were lighted, and the atmosphere generators were started. All equipment operated on 100 per cent propane-air gas without causing noticeable changes in burner characteristics. By 7 AM all furnaces were up to heat and operating on automatic control. This permitted resumption of normal production on schedule.

After approximately 24 hours of operation on 100 per cent propane-air gas, the company decided to experiment with the system. First the department was converted back to natural gas service and the results observed. No visible change was noticed in flame characteristics or operation of the equipment. After a short time, this process was reversed and the natural gas shut off and the propane-air gas turned back into the system with all equipment on automatic control. Again, there was no apparent difference in the gas flames at the various burners. This process of changing back and forth was repeated several times with similar results obtained each time.

These experiments indicated that the gas system would provide reliable standby service for the annealing department. They showed also that the plant could be started on very short notice and operations converted to the replacement gas without interrupting production. Only the most critical application at the gas torches required testing. Because the company knew the exacting conditions under which the torches must operate, they were reluctant to test this department with the propane-air gas. However, on Feb. 7 notification was received to reduce natural gas consumption at their two plants by 75 per cent. This meant utilization of propane-air gas in the department having the gas torches was necessary to continue production.

In converting the gas torches to the standby fuel, the methods employed for the annealing department were followed to determine if similar results would be realized. In addition, the propane-air gas was turned on while all equipment was in normal operation and without notice to the operators. The change was made gradually by opening the propane-air gas supply valve while simultaneously closing off the natural gas supply. Within a matter of minutes, conversion to the standby system was completed. Reports indicate there was no noticeable difference in flame characteristics or equipment operation. In fact, the torch operators did not know the gas supply had been changed until they were notified after the tests were finished.

This test proved the complete utility of the standby system. All plant equipment can be quickly converted from natural gas to 100 per cent propane-air gas or any proportionate mixture, with a minimum of effort. Continuous operation of gas fired production equipment is assured at all times.

MANUFACTURERS OF PRINCIPAL EQUIPMENT—ONEIDA LTD. INSTALLATIONS

Propane liquid storage tank	Downingtown Iron Works, Inc.
Unloading compressor	Brunner Mfg. Co.
Propane-air mixing unit	Selas Corp. of America
Mixed gas compressor	Worthington Pump and Machinery Corp.
Excess flow valves	The Bastian-Blessing Co.
LP gas shut-off valves	Wm. Powell Co.
Tank liquid level gauge	Rochester Mfg. Co., Inc.
Tank relief valves	American Car & Foundry Co.
Gas regulators	Fisher Governor Co.
Vaporizer	Richard M. Armstrong Co.

Editor's Note: PAUL E. PEACOCK, Jr., Westfield, N. J., consulting engineer and recognized authority on LP gas applications, designed the two Oneida Ltd. standby systems and collaborated on preparation of this article.

Power transmission

Engineering data and information to aid in selection, application and operation of equipment used in transmission of mechanical power

ROLLER CHAINS. . . . .PART 2 INSTALLATION AND CARE

Second and concluding article on roller chains includes pertinent information on installation and maintenance. These data—such as proper chain tension, alignment and lubricating methods—are important for successful operation and installation life

R. A. MOLLER, ***Associate Editor***

WELL SELECTED roller chain drives mean little if the installation is faulty and proper maintenance and care are lacking. The first part of this series of articles on roller chains explained steps to select the correct drive. The second part will emphasize installation and servicing.

Best performance occurs when the centerline of the sprockets approaches a horizontal. Centerlines approaching a vertical permit chains to hang away from sprockets, and an adjuster is required to take up the slack. Wherever possible, large sprockets should be located below, especially if the centerline is nearly vertical. When the center distance between shafts is long, the top span of the chain should be under tension. To obtain this tension, the top span should be the driver. When the lower span is the driver, the chain will tend to sag as it wears, and ultimately the upper span will strike the lower. This characteristic becomes more outstanding when both sprockets have small diameters and the speed ratio is low.

In operation, all roller chains are subject to a certain amount of wear. For this reason periodic adjustment is necessary to take up excessive slack. When shaft centers are not adjustable, slack may be taken up with an idler. This device should have an adequate number of teeth in keeping with the drive speed limitations.

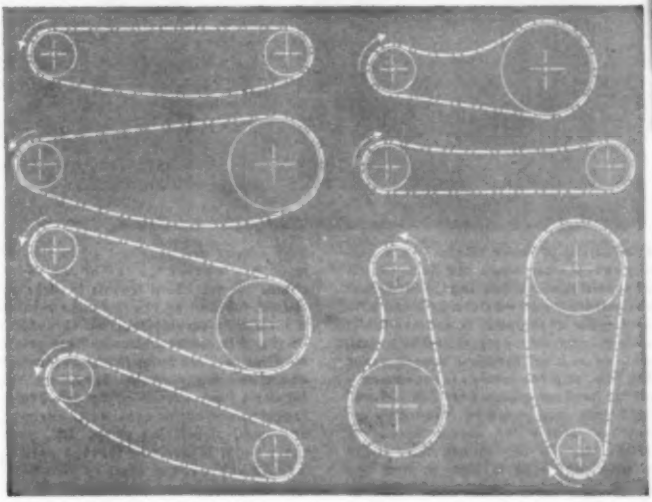
An idler may also be installed to take up slack in vertical layouts, or when uneven loads cause a whip in the chain. In such a case the idler should be of large diameter and located on the outside of the chain, on the slack span, near the smaller sprocket.

When chain length has been increased by wear, shortening the length is the simplest solution. This is easily accomplished by removing the worn link. If the chain has an odd number of links the offset link should be removed. When there is an even number of links, two links are removed and an offset link added.

Installation of a roller chain drive is not difficult. The little time and effort necessary will be offset many times by the increase in chain life. In general roller chains are precision-built for long life, and they will provide many years of satisfactory service. However, certain obstacles must be corrected at the time of installation. Following are factors to be carefully considered:

Alignment

1. Sprocket shafts must be parallel. Employ a spirit level on both shafts



The right (left) and wrong way (right) to install roller chains. For horizontal drives, the tension should be on the upper chain. A slight amount of sag is necessary, however, to reduce wear. Vertical drives should be avoided, unless chain is snug or an idler is installed

to check parallelism. Shaft-to-shaft distances should be measured on each side of the sprockets to be sure they are identical.

2. Sprocket teeth must be aligned or in the same vertical plane. This may be checked by laying a straight edge against the sprockets involved.

Obstructions

Neither pins nor sideplates should rub, strike or in any way contact another surface that could cause wear or misalignment.

Tension

Although a smooth operating drive should have a slight sag in the chain, new chains should be installed under slight tension. During the first few days of service roller chains tend to elongate slightly as pins and bushings are broken in. The chain should therefore be tighter than need be. This procedure will not affect machine bearings, because initial tension time is short. Chain on drives approaching vertical centers should be kept snug.

Lubrication

Improper lubrication will reduce chain life, and all new installations should be properly lubricated.

Wear

Worn sprockets should be replaced when a new chain is installed because deformed teeth will cause immediate damage.

Maintenance

After installation the roller chain should be kept in good condition through constant lubrication. Cleaning to dispose of grit and old grease is necessary. This may be done by scrubbing the chain in a gasoline bath with a brush. Chain clearances should be opened in order to allow gasoline to penetrate all parts. After scrubbing the chain should be rinsed in clean gasoline and drained before relubricating.

When a roller chain is worn out the best solution is replacement. Substitution of a few new parts should only be a temporary measure. Worn or broken parts can result in damage to other elements in the chain to an extent that efficiency is decreased.

TABLE 1—SAE VISCOSITY NUMBER FOR LUBRICATING CHAIN DRIVES

Temperature, F	Viscosity
20 - 40	20
40 - 100	30
100 - 140	50

Lubrication

Roller chains, in most cases, consist of precision-made bearings—pins, bushings, and rollers assembled concentrically—that roll smoothly and efficiently at every point of contact. Speed of the drive, operating temperatures, and hours of operation can do much to destroy efficiency unless the roller chain is properly lubricated.

Types of lubrication fall into three general classifications:

Type 1—Splash lubrication: Ideal for slow speeds under 600 fpm. The lower strand of the chain runs through an oil trough, which is kept at a level only high enough to reach the chain.

Type 2—Drip lubrication: Employed for medium speed drives of 600 to 1500 fpm. An oil cup or automatic device feeds oil through a pipe to the inside of the chain at a rate of four drops per minute. Rates up to 20 drops per minute are used occasionally for cooling and flushing high speed or heavy duty drives.

Type 3—Pressure lubrication: Utilized when speeds are over 1500 fpm. A small circulating pump operated by the driven shaft circulates oil to the inside of the chain.

When the drive must operate continuously, an automatic lubricating system is sometimes installed. This may be accomplished with an oil ring or a disc, which carries oil to a scraper. The scraper, located above the chain, performs the lubrication operation.

Lubricants

Type of oil depends largely upon prevailing temperatures. In general a light-bodied oil, which is fluid at the ambient temperature, is recommended. Heavy oils and greases are not recommended for drives, which operate at ordinary temperatures. These heavy lubricants, under normal conditions, are too stiff to enter the small clearances of a roller chain.

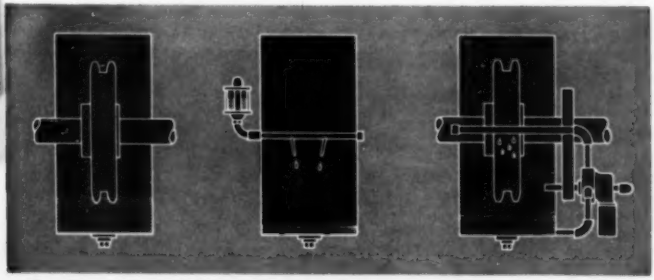
Method of Application

Lubricant, by the drip or pressure method, should be applied to the upper edges of the side plates on the lower chain span. If applied to the center of the chain or the upper span, the benefits might be negligible.

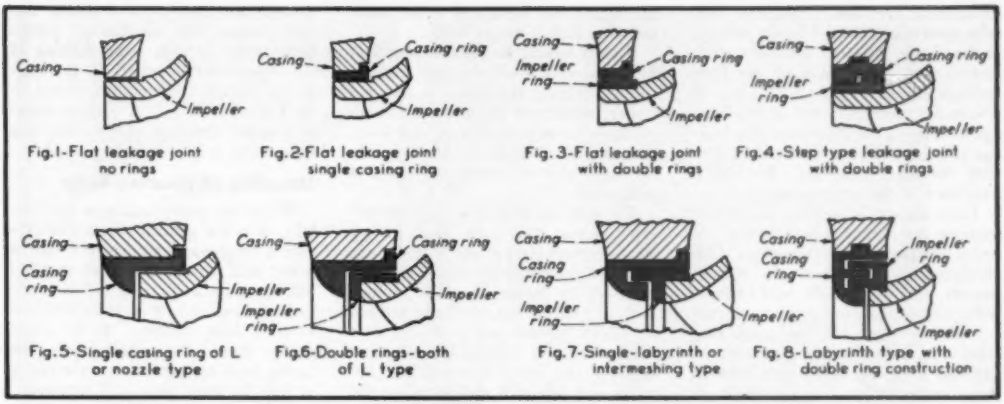
For single strand chain, the lubricant should be made to drip between the pin link plates and the roller link plates, on both sides if of large pitch; on one side if of small pitch. Double strand chain should be lubricated at the center plates and triple strand chain at both rows of center plates. For four-strand chain or larger, oil should drip on alternate rows of plates.

A simple guide to the success of lubrication is the color of oil at chain joints. When black, the lubrication is good. Definite brownish hue indicates poor lubrication. A more positive check may be made by examining the pins, which will appear bright and lustrous if lubrication has been effective.

Acknowledgment is made to the Atlas Chain & Manufacturing Co. for data in this article.



Lubrication of roller chains is a necessity, as in most cases the links consist of precision made bearings, which must run smoothly and efficiently. Three general types of lubrication are available: splash, drip and pressure. The splash method is ideal for slow speeds under 600 fpm, drip lubrication is recommended for medium speeds between 600 and 1500 fpm, and pressure lube performs best on chains for speeds exceeding 1500 fpm. In the splash lubrication method, a trough is built around the drive that is partially filled with oil. Best results are obtained when the oil level just reaches the top of the under chain. As the chain travels it picks up the oil, lubricating the links and retains a surplus to service the two sprockets. In the drip method, center illustration, oil drips through holes in a pipe located above the lower chain. Sprockets are serviced from excess oil on the chain. Pressure lubrication consists of a trough and small circulating pump. Oil, from the trough, is pumped through nozzles located above lower chain to give positive lubrication



Casing wearing rings, sometimes called impeller guide rings, are removable inserts in the casing that protect the casing from wear, while the impeller rotates. Some rings are designed as seals

CENTRIFUGAL PUMPS . . . . . IMPELLER WEARING RING APPLICATION

IGOR J. KARASSIK AND ROY CARTER,
Application Engineers
Worthington Pump & Machinery Corp.

Second and concluding part on the application of centrifugal pump impellers. This part discusses the types of wearing rings best suited to given conditions and tells how to prevent wear on adjacent surfaces of the pump casing by running clearance

IN order to avoid wear at the adjacent surfaces of a pump casing and a closed impeller, separated by a running clearance joint, a removable ring or rings are used at such a joint. The wear is then taken on a part or parts replaceable at a lower cost than would be the case if the casing or the impeller running joint rotates.

Casing wearing rings, sometimes called "impeller guide rings" are a removable ring inserted in the casing to protect it from wear and in which the impeller running joint rotates.

When desirable to protect the impeller from wear at the running joint within the casing or casing ring, it is fitted with a removable ring, which is called an "impeller wearing ring". When a pump has renewable rings both on the impeller and in the casing, the pump is said to be provided with double wearing rings.

Ring construction type varies with the character of the liquid being handled, the head differential across the leakage joint, the rubbing speed and the particular pump design. Generally speaking, pumps have ring designs, which the manufacturers have found by experience to be suitable for the service for which the pump will be used.

Flat rings are a type of wearing ring in which the leakage joint is a straight annular clearance, Fig. 2 and 3. However, this type has been replaced very extensively by the L type shown in Fig. 5 and 6. The flat and L type rings are the most commonly used.

L shape casing ring, or commonly called nozzle type ring, is fashioned in the shape of an L laid on its side. The short bar of the L covers the radial face of the impeller or impeller ring, which would otherwise be exposed to incoming flow. This construction avoids the emergence of the wearing ring leakage into the suction stream at an angle almost perpendicular to the flow of liquid, a condition, which would cause induced currents and hydraulic losses. The leakage joint proper is along the long bar of the L with the clearance on the short bar of the L being larger. The L shape ring is basically a flat ring with an apron.

Labyrinth rings have two or more annular clearance leakage joints connected by relief chambers with low flow velocities, Fig. 8. Leakage through a ring is a function both of area and length. A longer leakage path of the labyrinth ring permits the use of a larger area so larger clearances between the rotating and stationary rings can be used. The step ring and the intermeshing ring are both sub-divisions of the labyrinth ring group. A labyrinth ring with two annular clearance joints of different diameters involving one reversal of flow, is often called an intermeshing ring, Fig. 7.

A step ring is the name applied to a wearing ring design utilizing, in effect, two flat ring elements of slightly different diameters on the total width of a leakage joint. It is not very commonly used, Fig. 4.

Wearing Ring Location

Amount of leakage through a leakage joint is controlled by three major factors: the area, length of the path and

differential pressure. Leakage is likewise somewhat affected by the manner in which the designer provides acceleration and deceleration of the flow through the clearance joint. Thus, to obtain the minimum area so the leakage will be at the minimum, the leakage joint should be at the smallest possible diameter, and, thus, the logical location is at the impeller eye.

There are specific applications where locating the wearing ring at the impeller periphery is advantageous. One example is vertical single bottom suction pumps, which will handle water containing sand or grit and may be idle at times. If the usual ring should be located at the eye, sand or grit may settle and accumulate between the impeller and suction head wall. A good portion of this space may even be filled if the unit is a submerged type and idle for a considerable period. When a pump, in which such an accumulation of sand has been deposited, is started the concentration of sand will cause rapid wear. If it has become packed solidly in part or all of the space between the impeller and suction head additional damage may be caused. In such a case, locating the rings at the periphery, with the space between the impeller and the suction head open to the suction nozzle water ways, avoids the pocketing of the sand. In spite of the higher rotative speed at the joint, the rings have a longer life.

Besides having the disadvantages of increased area and increased rubbing speed, locating the rings at the periphery would not be desirable for application in regular commercial lines. The impeller diameters employed in the same size of casing vary over a wide range.

The question may arise as to the advantages that may accrue from having wearing rings both at the impeller eye and near the periphery of the impeller, in order to reduce the leakage loss. Such a construction has been utilized for a few sewage pump designs with the basic idea of excluding solids from entering the space between the impeller and side wall and to reduce the wear of the rings, which is relatively rapid due to grit. It could not be advantageously used for high head pumps as the set of rings at the periphery would increase the rotating surface, thus causing additional disc horsepower losses offsetting any saving in the leakage loss.

Descriptions of the previous wearing rings were based on rings having radial clearances. Rings with axial clearances have been used for centrifugal pumps but have not been as popular as those with radial clearances. Due to casting variations it is generally desired that the design of double suction pumps, and multi-stage pumps particularly, permits some shifting of the impeller or impellers on the shaft so the impeller is closely centered in its volute. The use of leakage joints with radial clearance permits this, but those with axial clearance do not.

Mounting of Wearing Rings

When the pump casing is split axially, it is the general practice to provide a tongue-and groove joint in the lower half of the casing so that the bolting of the two casing halves firmly locks the casing ring in place and prevents it from rotation. If the pump casing should be radially split, the casing rings are pressed into the casing or into the stage piece and, frequently, bolted in place.

Depending upon the type of pump, the intended service and the expected frequency of impeller ring renewal, the latter may be pressed or screwed on the impeller hub. In addition, it is the general practice to hold the impeller ring in place by means of set screws, or other fastening devices.

There have been some designs of wearing ring mounting, where the impeller ring is shrunk onto the impeller. This design, of course, is restricted to materials which permit such an assembly.

REPAIR THAT CONVEYER BELT IMMEDIATELY

IN order to get the maximum service life out of conveyer belting, industrial users should take particular care to repair all belt damage as soon as it is discovered. Belt fabric exposed to weather will absorb moisture if the protective cover becomes damaged. In warm weather, this condition leads to mildew and rot. In winter, ice crystals may gnaw at the fabric from within as the belt flexes. Thus, immediate repairs not only prevent the spread of damage, with its threat of premature failure, but also keep out water, which is the natural enemy of any conveyer belt.

The simple tools and procedures outlined here will help maintenance men give belting proper attention. An adequate repair kit includes sharp cobbler's knives and a stone to keep them sharp; a supply of emery cloth, rubber cement, inner tube patching rubber, rip plates and standard belt fasteners and accessories, together with rags and gasoline for cleaning. As each belt is installed remnants should be kept, because they will prove useful in subsequent repairs.

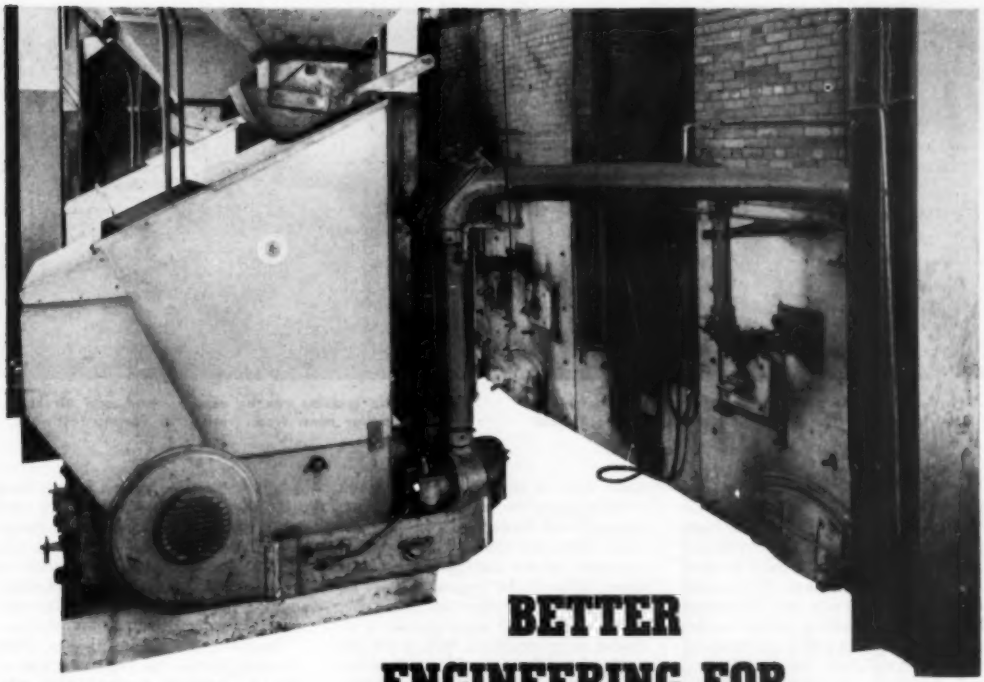
To mend long and deep cuts, which go through to the fabric, open the cut, clean out all dirt, and cement the cut closed, allowing the cement to dry thoroughly before the belt is restored to service. Where bits of torn cover leave exposed spots with only slight damage to the fabric, remove the loose ears of cover stock by carefully cutting a curved and bevel-edged area around the spot. Then sand the edges, apply cement, allow it to dry, apply tire patching rubber and finally skive the patch flush with the belt cover.

Where gouges have penetrated the belt, or longitudinal rips have occurred, these points must be cleaned, sanded, cemented and reinforced with rip plates at three inch intervals. Transverse rips require similar treatment with standard belt fasteners instead of rip plates. Use rip plates on longitudinal rips and standard fasteners on transverse rips. When holes in belting do not permit the simple use of rip plates and fasteners, cut the hole into the smallest possible rectangle with its sides parallel to and at right angles to the belt edges.

Then, from belting remnants, cut an exact fit for the hole and insert the piece, fastening it with belt fasteners all around the patch. Cement all edges thoroughly. When it is necessary to prevent seepage of fines through belt repairs, remove one ply of fabric from a belt remnant and place it under the fasteners and rip plates.

Vulcanized patches are superior but require a portable vulcanizer, rubberized fabric, tie gum, cover stock, a one-ply knife and fabric pliers. In preparing a vulcanized patch, work down into the damaged belt as far as necessary by removing progressively smaller blocks of fabric with each successive ply. Clean, roughen and cement the cavity, neatly fit in blocks of new fabric and finally apply the uncured cover. Skive the edges of the patch flush, and vulcanize. Such patches cannot be made successfully unless the belt is dry, because the presence of moisture will permit the development of internal steam blisters.

Courtesy of Newell Perry, Thermoid Co.



Gravity coal flow from overhead bunkers combined with pneumatic feeding provides one convenient firing method for small plants

BETTER ENGINEERING FOR SMALL STEAM PLANTS

Efficient utilization of our enormous coal reserves depends on competent engineering and well designed equipment. Here are suggestions intended to satisfy these requirements economically for smaller plants

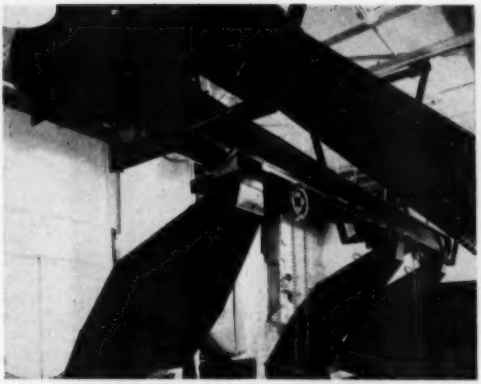
WILLIAM S. MAJOR, ***Project Engineer,***
Power Department, Dravo Corp.

As the defense program gains momentum, greater attention is being paid to its impact on availability of fuels. Of particular importance is coal, the source of vital coke for steel, and principal fuel for generating electricity needed to produce scores of defense materials. Fortunately, there are vast reserves of coal and production can be rapidly expanded. Greater attention, however, must be given to more efficient utilization of coal carrying cars and additions to the fleet. In the case of oil, less will be used as boiler fuel, and refining techniques will be changed to provide the maximum quantity of fuels suitable for tanks, trucks, automobiles, diesels and all types of aircraft. Under the stimulus of the defense program, research developments may further reduce the quantity of residual fuel oil. Fig. 1 shows just how the average yield of principal products per barrel of crude oil has changed between the years 1920 and 1950.

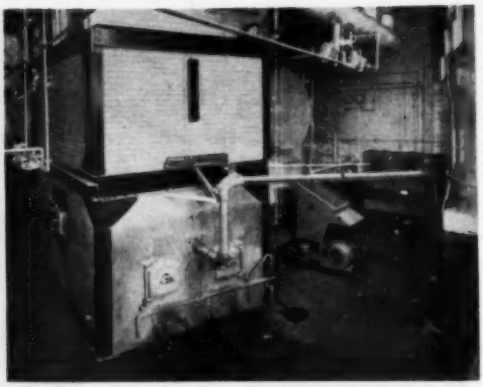
Because of the oil shortage, the East Coast has already swung from the preponderance of oil firing of about two years ago to coal. These changes of fuel are no particular concern to larger plants, since most of the larger boilers are designed for either coal or oil firing. Many smaller steam plants, however, are not designed to efficiently receive, store, handle and burn coals. Although these facts have been known for a long time, there had been no suggested plan for improving conditions until approximately two years ago. Since then, Payne (1) has been periodically discussing the problem and endeavoring to organize a Fuel and Engineering Consulting Service to meet the needs of smaller steam plants. His latest activity was the organization of a Panel Discussion, which was presented at the last Joint Fuels Conference (2). In that session, the views of a representative of a small plant owner, consulting engineer, coal producer, equipment manufacturer and construction contractor were submitted. Their views on this important problem are presented in this article.

Viewpoint of a Small Plant Owner

Yearly fuel bills for General Foods steam plants of 5000 to 50,000 lb per hr capacity are relatively small, and it is difficult to justify expenditures for fuel savings. In most plants, one operator per shift is employed and occasionally an extra man during the day



Many arrangements of mechanical conveying equipment have been employed to reduce manual handling of coal



Pneumatic systems can be used to feed coal directly to the boiler room from storage at remote locations

for unloading coal, handling ashes and general boiler room housekeeping. Efforts to eliminate the light load night operator through automatic devices are frequently prevented by local or State Department labor laws or the fact that the attendant also acts as a watchman. When manual handling of coal reaches a condition that requires a second operator, expenditure for mechanical coal handling equipment generally proves more economical than adding the second operator. Representative types of equipment that have been used include: scoop lift trucks, overhead monorail with bucket hoist, single inclined conveyer and depressed coal pit with pneumatic spreader stoker.

Since the small plant manager cannot be expected to know much about steam generation, special attention should be given to those design features that assure maximum continuous service and ease of repair. The boiler unit should be suitable for fluctuating loads, prolonged periods of light loads and performance with only fair feedwater treatment. When utilizing coal, firing equipment and furnace should be designed to use the coals that will be economically available to the plant.

In expanding the steaming capacity of existing plants, evaluation studies and equipment selection are frequently restricted by space limitations, which determine size and shape of the material that can be installed. For new plants, however, comprehensive engineering studies can be conducted since there are no physical restrictions in carrying out the dictates of best engineering practice.

Viewpoint of a Consulting Engineer

Many consulting engineers pay little attention to smaller steam plants because there is too much contact work involved to allow economical solicitation of such business. Spending the same effort and time on a few larger prospects, whose management is more appreciative of the engineering problems involved, proves more attractive. In many cases, the steam system is included as an incidental item in the design and construction of a small industrial plant. Under such circumstances, the architect or engineer may not be a specialist in steam generation, and could inadvertently overlook many features of design that are essential for maximum reliability and economy during the plant's life.

The small steam plant warrants substantially the same study as larger plants. Studies of steam load characteristics and fuel surveys should be conducted to determine the necessary data for proper equipment selection and general plant design. This phase of engineering development may take considerable time in existing installations, since plant records are generally meager on both performance and equipment details. Quite likely, meters may have to be installed to definitely establish steam demands, and field measurements taken if records of plant design are inadequate or incomplete.

To aid in proper fuel studies, there is a need for a coal industry guide or manual showing characteristics, sizings, preparation, etc. of the coals that can be furnished in various consuming areas. Such a reference would be of considerable benefit to the consultant while selecting fuel burning equipment and furnace design for a particular application.

Viewpoint of a Coal Producer

During recent years, there has been a rapid drop in the coal tonnage consumed by small steam plants as a result of the inroads of the so-called

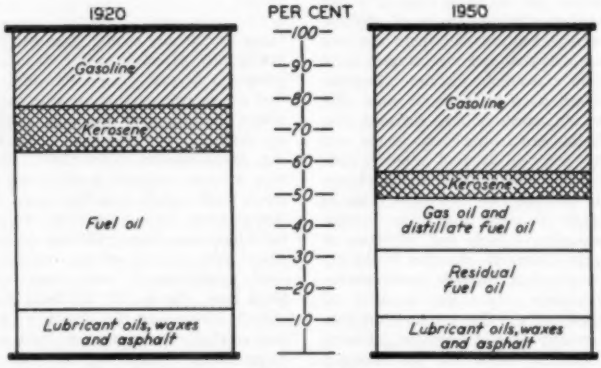


Fig. 1—Average yield of principal products per barrel of crude oil
Source: American Petroleum Institute

"laborless" fuels, oil and natural gas. One important cause of this loss is the declining advantage in delivered cost per million Btu that coal has long enjoyed in most markets over inherent fuel value of oil and natural gas. Some evidence indicates that this cost margin has reached a minimum, and the trend may be on the verge of a reversal. With military requirements mounting, it is important that our relatively limited reserves of oil and gas be conserved whenever possible. This necessity is reflected in reports from large suppliers of coal that indicate many fuel burning installations being built today are designed basically for coal or include provisions for multiple firing.

Since most small plants do not have combustion engineers to maintain efficiency, performance drops rather quickly below the potential of the original design. Coal burning plants, particularly, degenerate through careless or incompetent operation, improper fuel application and excessive maintenance. As these conditions continue, a dissatisfaction with coal is bred and plant owners frequently look to liquid or gaseous fuels to be the panacea for all the problems of steam generation and air pollution.

To raise standards of plant operation and provide improved engineering for both modernization and new plants, a Fuel and Equipment Consulting Service is proposed. This service would be established by the coal industry and its activities guided by a director of engineering with a staff. For each area, there would be a regional advisory committee composed of engineers representing producers, equipment builders and consultants whose interests are allied with fuel and equipment in the particular area. The advisory committee would supervise all technical promotional activity, provide engineering service and formulate policies involving fuels and equipment that are beneficial to those in the area.

An important and necessary activity under this engineering program would be the development of Standardized Plans and Specifications designed primarily to permit one man per shift operation of small coal fired steam plants. The Packaged Plans would combine boilers, combustion equipment, coal and ash handling equipment, controls and all necessary auxiliaries into well engineered combinations to permit efficient utilization of coal sizes and grades normally available in each area. All plans would be approved by the Regional Committee because of their familiarity with local conditions, equipment preferences, local regulations and laws covering installation and performance of fuel burning equipment. These plans would be available through consulting engineers chosen by the small plant owner to execute the complete project. Some minor modifications of the plans will periodically be required in order to adopt them to the consultant's engineering study or plant conditions.

Viewpoint of an Equipment Manufacturer

Two important reasons for poorly engineered small steam plants are; (a) many plant owners do not believe expert counsel is necessary or economically justified and (b) the consulting engineer's return is often small for the amount of time required to prepare a thorough engineering study.

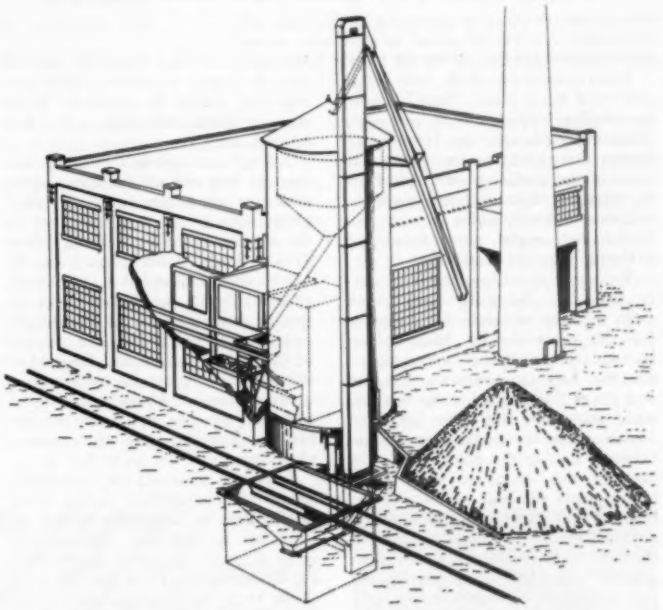
The manufacturer can help to improve this situation, and thus insure better performance from his products, by the following activities; (a) more actively encouraging purchaser to retain consulting service, (b) preparing better application data for the consultant, (c) closely following installations, whenever possible, to assure that the equipment is properly applied, operated and maintained, (d) publicizing to consultants and prospective purchasers the performance of typical, well engineered, modern plants and (e) providing engineering guidance on proper operation and maintenance.

For the small coal fired plant, various types of mechanical and pneumatic equipment are available that can be arranged to feed coal directly from the storage bunker to the boiler. In addition, automatic ash removal by mechanical or hydraulic systems aids in keeping manpower requirements at a minimum.

Viewpoint of a Construction Contractor

Generally, the consulting or plant engineer determines from heat balance and fuel studies what type of equipment should be installed. Thus, the construction contractor does not normally exert a major influence on basic engineering of small steam plants.

The construction engineer usually functions as an aid to the consulting or plant engineer through development of the many details that are necessary before the steam plant becomes a reality. For instance, the construction contractor is frequently asked to assist or take full charge of such duties as; (a) solicitation and analysis of equipment bids, (b) co-ordination of details, (c) development of delivery schedules to assure maximum economy of erection and (d) supervision of erection, in-



This diagrammatic drawing illustrates fuel flow outside of the plant. Adequate silo storage can prevent repeated handling on the yard pile

Some plants utilize coal loaders mounted on bulldozers or tractors for distributing, compacting and reclaiming coal on outdoor storage piles

cluding the furnishing of all the labor.

From association with both large and small steam plants, there has been an excellent opportunity to see many engineering features on large installations that should be incorporated in more of the smaller plants. Admittedly, some of these features would be difficult to justify under present conditions, but might prove feasible if evaluated over the plant life.

Frequently, operating problems and/or excessive operating costs result from inability to obtain fuels suitable for the plant design. Many plants contain equipment that was designed for the fuel characteristics, supplies and prices that applied at the time the plant was built, but were far from representative of conditions to be anticipated during the plant's life. Because of this, there are many small boiler plants with one or more of the following characteristics; (a) inadequate grate area, (b) small combustion chamber, (c) poor furnace configuration, (d) obsolete firing equipment, (e) limitations on boiler output, (f) restrictions on firing possibilities, (g) no suitable space for coal storage, and (h) insufficient space for routine servicing and maintenance.

In the modernization of existing small steam plants and the design of new ones, there are many operating conditions that are not common with larger steam plants. Unless these factors are properly analyzed, the costs of improvements or equipment may prove out of proportion to the potential gains. For instance, the annual fuel consumption per installed boiler horsepower in small plants is generally lower than in larger plants, since steam loads are principally seasonal heating and/or process demands and may require only 2400 to about 3600 hr of operation per year. Confronted with this, benefits of mechanical fuel burning equipment and automatic controls must be largely justified on labor savings and ability to maintain better stack discharge conditions, rather than on fuel savings.

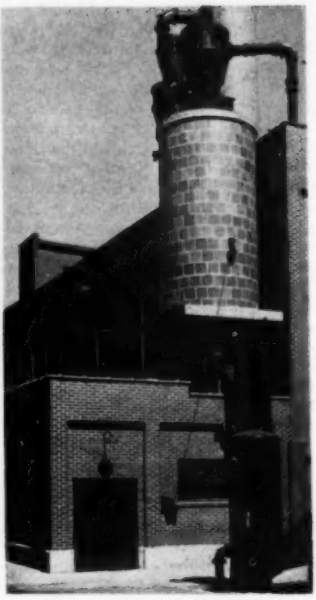
Savings accomplished by using mechanical coal and ash handling equipment are most promising in small plants. One of the best references on the subject is the publication, "How To Cut Small Boiler Plant Costs By Mechanical Coal and Ash Handling" (7). It covers a detailed report of extensive studies sponsored by Bituminous Coal Research, Inc. and conducted by Miller, Carlson and Engdahl of Battelle. The report discusses and illustrates typical layouts, investment costs and types of equipment that are being used for lowering steam costs in plants ranging from 30 to 300 hp.

Reduction of smoke (8) and cinder discharge is a problem facing many small plants as legislation against all forms of air pollution continues to grow. Changes in operating practices, closer supervision, overfire jets (9), cinder traps and dust collectors (10) have all proven effective in the abatement of objectionable stack discharge.

Summary

Although many small plants need the services of a consulting engineer to design efficient steam systems for them, there is a problem of how to provide this engineering economically for a larger segment of industry. In many cases, fuel costs are only a small percentage of total operating costs, and the plant owner fails to visualize that fees for consulting services pay good dividends. The owner too frequently looks to fuel savings as the sole means of justifying the fee. Credit should also be given to such benefits as fuel flexibility, added plant reliability and lower labor costs that accompany more comprehensive engineering. Even with proper credit for these benefits, it is difficult to establish an engineering fee that will be interesting and profitable for both owner and consultant.

Standardized Packaged Plans and Specifications appear to be the practical, economical means for providing a higher order of engineering design for small steam plants.



Ash removal creates a problem in many plants. Automatic disposal systems are frequently installed to help alleviate this condition

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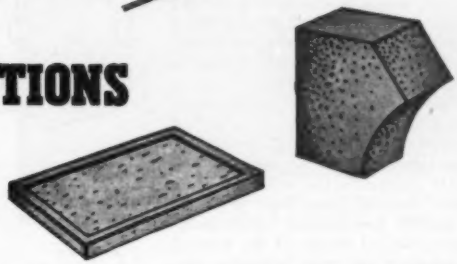
CASTABLES SIMPLIFY REFRACTORY APPLICATIONS

Many types of refractory concrete are available that have been designed to resist corrosion and abrasion, withstand high temperature or provide low thermal conductivity. These properties plus a variety of possible installation methods aid erection and maintenance of refractory projects



The cold setting properties of castable refractories permit precasting of burner blocks, car tops, door linings and special shapes in any required quantity

CASTABLE refractories are essentially concretes designed for high temperature service in furnaces and other industrial heating units. Gravel or crushed rock, normally employed as a base in standard forms of concrete, is replaced by refractory aggregates or grogs that are stable at high temperatures. This structure permits repeated heating and cooling cycles without causing disintegration.

Suitable hydraulic binders are mixed with the aggregates to furnish cold setting properties for the castables. Initial strength develops from chemical action between the water and these binders, similar to the setting action of ordinary concrete. In addition, if the operating temperature exceeds the vitrification point of the refractory grogs, a ceramic bond would be formed.

The principal reason that castables are being utilized for an increasing variety of services is the economy involved. These materials can be cast in place, precast to special shapes, sprayed with a cement gun and plastered in place with a trowel. This often reduces the cost of erection and maintenance.

Of course, no one castable could be employed economically for the entire range of services that these materials cover. Different aggregates provide a variety of physical properties, each designed to meet specific applications. The exact conditions must be established to permit selection of a castable with the necessary characteristics.

In general, the two classifications for which castables can be used are: (1) service at temperatures high enough to cause a ceramic bond to form, and (2) service at temperatures below the vitrification point but high enough to cause disintegration of regular concrete. Numerous applications within each of these ranges have resulted in the wide variety of materials that are now available.

Where the service temperature causes vitrification, the castable refrac-

Sprayed linings are particularly suitable for applications such as ash hoppers where resistance to sulfur corrosion and abrasion is required

Cement guns can be used to spray refractories on various surfaces

tory employed has structure with characteristics corresponding to those of dense fire brick. They have good volume stability and do not expand or shrink permanently even after repeated heating and cooling cycles. Typical applications include burner blocks and special shapes, covering studded water walls, boiler baffles and floors, cast car tops and partial or total process furnace enclosures.

Castables exposed to temperatures that cause disintegration of standard concrete also find varied application. Some services require only heat-resistant qualities in the refractory while others demand insulating properties to provide low thermal conductivity. Often installed weight of the material is important and most insulating concretes possess this necessary feature.

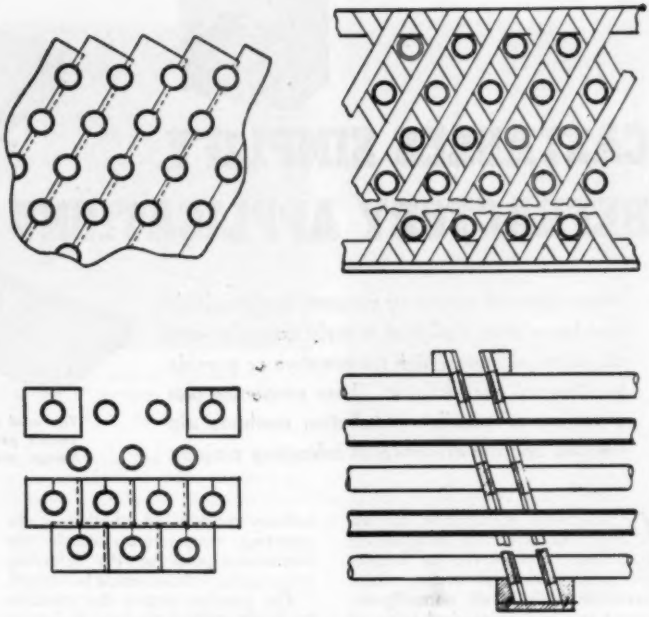
Examples of heat resistant applications are furnace foundations, hot air and gas ducts, cleanouts and explosion door linings and floors exposed to soaking heat. Where heat loss and personnel comfort are involved, castables with insulating characteristics provide the desired result. Essentially, location and service conditions will determine the type of castable employed.

Insulating concrete furnishes special value when used in certain boiler sections. Modern steam generators often feature tube supported refractories, which require lightweight construction combined with insulating properties. Castables poured in place form monolithic walls around the supporting studs or clips welded to the boiler tubes and satisfy these specifications.

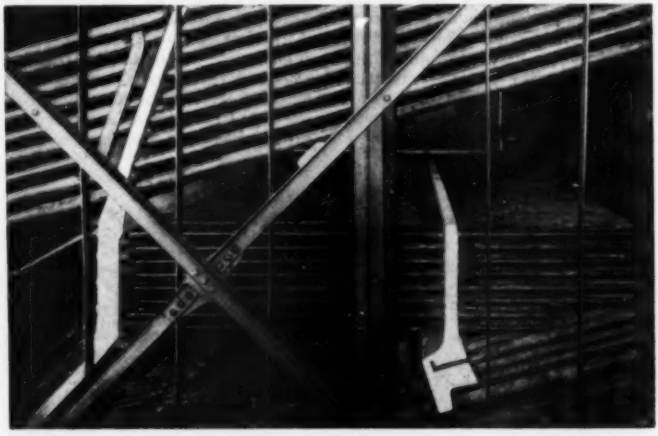
Construction and maintenance methods that can be employed with castables are nearly as valuable as the physical properties of the materials themselves. Pouring boiler baffles in place, using wood forms, greatly facilitates erection especially where they cross closely spaced intricate tube patterns. Forms for baffles, poured flush with the outside of tube banks, sometimes employ heavy waterproof paper for the inside surface and plywood panels for the outside section.

While poured sections require a mixture that flows readily, other projects need a stiff consistency that is still plastic. Repairing baffles or spalled brickwork, patching burner blocks and constructing door linings in place without forms are examples of this type of application. Normally these refractory mixtures are applied with a trowel and float finished, if a smooth surface is necessary for good appearance.

Vertical or inclined surfaces are often refractory coated, the material being sprayed on with a cement gun. Reinforcement may be provided, if desired, using heat-resistant steel where



Forms for boiler baffles are generally constructed of wood strips set between the tube rows. This illustration shows a typical arrangement

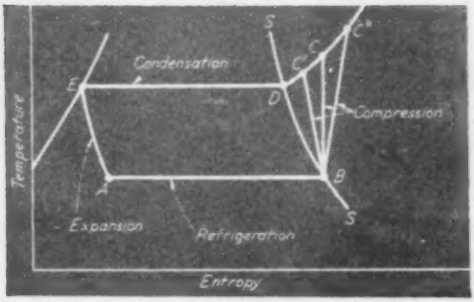


Free flowing mixtures are employed for pouring monolithic baffles to assure effective filling of the complex spaces between the tube rows

excess temperature would cause carbon steel to lose strength. Stack interiors, ducts, ash pits and other surfaces are often lined by this method.

While castable refractories may represent only a small portion of the materials in certain installations, they are equally important. They must protect other equipment and provide comparable service continuity. That they possess the durability to warrant the investment is being proven in many applications throughout industry.

Data and illustrations used in preparation of this article were made available through the courtesy of The Babcock & Wilcox Co., Laclede-Christy Co., Refractory & Insulation Corp. and Universal Atlas Cement Co.



Temperature-entropy charts indicate theoretical relationship between the refrigerant gases and liquid in the cycle

Discharge and suction valves on the compressor should be fully opened, and piping must be installed without bends

COMPRESSOR DISCHARGE TEMPERATURES

IN THE OPERATION of some older types of mechanical refrigeration compressors, the discharge temperature is usually well above the theoretical adiabatic temperature as determined from the temperature-entropy charts. Even though these machines are kept in good mechanical and operating condition, this high temperature persists.

Generally, it is caused by high gas velocities, which are apt to occur more often in older machines than in modern designs because of smaller ports and valve areas. Whenever the refrigerant makes numerous twists and turns in the machine, valves and ports, then the discharge temperature will invariably run high. Tight piston rod packing, piston rings and bearings can also add heat to the gas. An increase in compressor speed will also cause higher discharge temperatures. Under such conditions, the cooling medium will not always compensate for the heat added to the discharge gas, and temperature of the latter will always run high. In particular, this is apt to happen in a newly overhauled machine where friction exists in the working parts, and where new valves and repaired ports cause high gas velocities.

Additional explanation of these facts requires reference to the theoretical refrigeration cycle, usually drawn on a temperature-entropy chart.

Point B represents the state of the refrigerant leaving an evaporator and entering a compressor. Usually in this state, the gas is nearly dry saturated vapor. That is, point B is near the saturation curve S. BC represents adiabatic compression during which the gas is superheated.

At C, the superheated vapor passes into a condenser and is cooled at constant pressure, as indicated by CD. It is then cooled further and finally condensed at constant temperature along the line DE. The liquid then flows through an expansion valve and into the evaporator, completing the cycle. Because of the throttling action, the liquid expands into gas. This occurs along line EA. Refrigeration takes place as the gas absorbs heat, as indicated by AB.

This theoretical cycle assumes adiabatic or constant entropy compression along the line BC, during which time there is no passage of heat to or from the gas within the compressor cylinder. In practice, it would be impossible to insulate a compressor well enough to attain this condition. In fact, a compressor should not be operated on a truly adiabatic cycle, because it would become extremely hot and lubrication would present too serious a problem.

However, in all machines, (as explained above) the gas is compressed from a nearly saturated condition to a high-temperature or superheated condition. In the theoretical T-E cycle, this is adiabatic or constant entropy compression along line BC, and the gas reaches its maximum temperature at point C.

In actual practice (with a well-designed compressor without excessive gas friction in ports, valves and passages, and with adequate jacket cooling) there is a decrease in entropy. Compression will fall along line BC', with area BCC' being a visual indication of the reduction of the work resulting from jacket cooling. Under such conditions, there is a reduction in discharge temperature. Superheat is reduced without affecting pressure adversely. Power requirements for the compressor are ideal.

Many conditions in the operation of old compressors cause an increase in discharge temperature, moving the point C' closer to C where the gas attains a temperature comparable to that after pure adiabatic compression. Furthermore, these conditions may be such that the discharge temperature exceeds that after adiabatic compression, which occurs along line BC''. The latter would obviously result in excessively high discharge temperature, as indicated by C''.

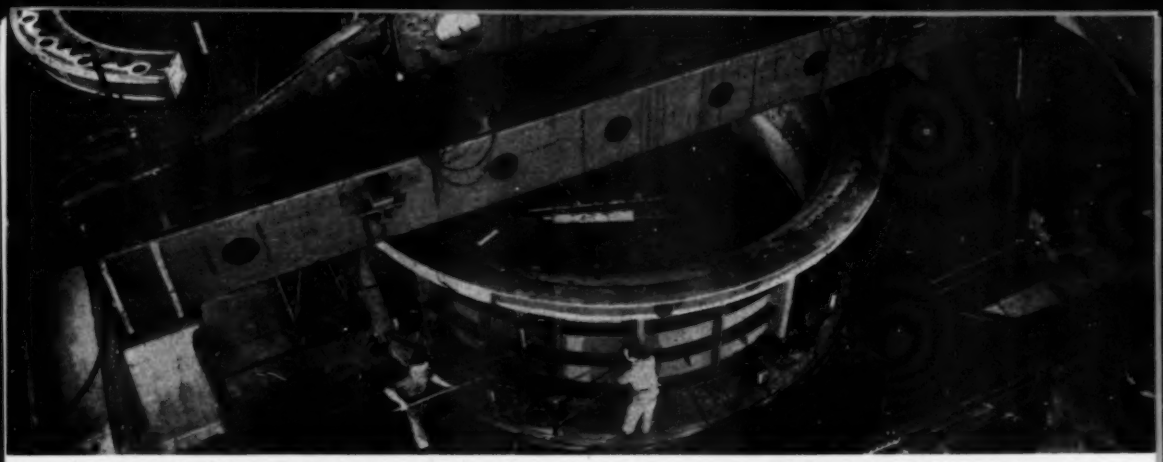
Some of the conditions to check are as follows:

(1) High friction in moving parts of the compressor, particularly in rod packing, piston rings, bearings and valve mechanism. Heat is continually passing into and out of the refrigerant during its passage through the compressor, and friction heat should be kept to the minimum. Lubricant must be correct for the machine. All passages should be checked for restrictions.

(2) Poor jacket cooling causes high temperatures. Cooling water temperature differential and quantity may be correct, but heat from cylinder walls will not be carried away because of scaled passages. Scale is a heat insulator and will cause heat from piston friction to go into the gas, rather than to the cooling water.

(3) Correct pressure drop through suction ports and valves is necessary. High suction requires the compressor to do more work on the gas, increasing its temperature at the beginning of compression and adding its effect to high discharge temperature.

(4) Correct pressure drop through discharge valves and ports is also important. On suction and discharge lines, restricted and scaled passages, high-friction valves and pipes, sharp pipe bends, improper pipe sizes and similar factors cause wiredrawing of the gas. This requires the compressor to do more work, thereby raising gas discharge temperature.



This $400,000 vertical boring mill, one of the world's largest, bores, turns and faces hydraulic turbine parts. Sunoco Way Lubricant, approved by 38 machine tool builders, was selected by the design engineers to prevent stick-slip with resultant poor finishes and scoring of ways and slides. On this machine, even with work as heavy as 75 tons, Sunoco Way Lubricant has never squeezed out.

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Now 95 bottles a minute can be processed continuously by this washer, thanks to a Sun Adhesive Pressure Grease. In the past, shutdowns were required after short intervals because the lubricant then in use did not adhere, leading to open gear failures.

pumps, low-speed diesels, and general lubrication where a high-quality straight mineral oil is needed.

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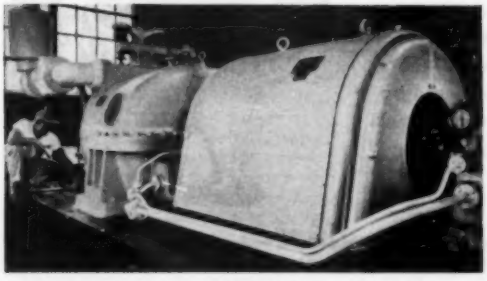

This turbine supplies most of Nantucket Island's power during summer peak loads. In winter it is idle, but journals, bearings and controls always remain free of sludge, rust and corrosion—because Sunvis 916 protects them. Its metalwetting characteristics prevent any moisture present from displacing the oil.

Gates, valves and capstans—the entire mechanism of this new Monongahela River lock—operate hydraulically. The engineers in charge chose Sun Hydraulic Oil over all others because they felt it could be best counted on to keep the lock in operation and river traffic moving despite extremely rigorous conditions.

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The famous Dayton Thorobred is made with *three prime sections:* 1. *Tension* section specially compounded to give and flex easily as belt goes around pulleys, to reduce cracking and heat build-up . . . 2. *Strength* section of electronically processed high-tenacity rayon cords for great strength and long life . . . 3. *Compression* section that combines great crosswise rigidity with easy compression, to prevent squashing and bulging in pulley grooves. No wonder Thorobreds give you so much more *belt life* for your money!

I'm "COG"—for "tough" drives...small pulleys...short center distances!

The Dayton Cog-Belt* makes tough drives easy! Scientifically designed to bend as easily as your finger, the Cog carries 40% more power than conventional V-Belts—5 Cog-Belts do the work of 7 conventional belts! Because it *bends* easier, the Cog-Belt operates over smaller pulleys and shorter center distances. The Cog-Belt can save 28% of your drive weight—47% of your drive space! And the Dayton Cog-Belt *outlasts* any other V-Belt on tough drives, because since it bends easier, it runs *cooler.* Prove it to yourself on your "problem" drives!

*T.M.

See "Belting" in the yellow pages of your telephone directory, for the name of your Dayton Distributor. He can tell you which Dayton "Twin" will save the most money on your drive!

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Handbook for engineered plant services

Methods, data and ideas that make excellent references in solving engineering problems frequently encountered in plant operations

HOW TO USE A PORTABLE POTENTIOMETER TO CHECK THERMOCOUPLES

W. C. LONGSTRETH, *Brown Instrument Division, Minneapolis-Honeywell Regulator Company*

MANUFACTURING PLANTS and power plants most frequently use thermocouple pyrometers for temperature measurement. When received from the factory, the thermocouples will generally be found to match the output given in the temperature emf tables supplied by the manufacturer very closely, but during the period of service, characteristics change. Protecting tubes retard deterioration, but cannot prevent it entirely.

The extent of the error depends on type of thermocouple, temperature at which it is used, atmosphere to which it is exposed, and length of time it has been in service. It is seldom possible to determine extent of deterioration except by actual check, as factors affecting accuracy vary with installation.

One of the most satisfactory methods of making periodic checks is by means of a portable potentiometer which employs a sensitive galvanometer and a bridge circuit for electrical balance. These instruments are light and entirely self-contained. They are inexpensive, with an accuracy of 1/5 of one per cent.

Measurements are made by balancing an unknown emf, (that of the thermocouple under test) against a known (or standard) voltage. There are no hair springs to weaken and cause errors. By use of the instruments, it is possible to check not only the thermocouples, but also accuracy of the instruments by which thermocouple outputs are read.

To test a thermocouple, a reference standard which is known to be accurate must be used. It is common practice to employ another thermocouple of the same type and size as the one under test. A new one, whose calibration has been determined by comparison with a primary standard or directly against platinum, may be used as a standard. It should be labeled accordingly and reserved for this purpose. Since its original characteristics will change gradually, the standard should be tested at intervals, and replaced when it has passed the desired limits of accuracy.

There are several methods of testing used thermocouples, and selection of the method will depend on type of installation. Success of the tests depends on the stability of the temperature during the process. The methods are suggested in the order of preference:

1. Insert a reference standard in the same protecting tube as the thermocouple under test (if the size of the tube permits). Connect one thermocouple to each pair of binding posts on the potentiometer and compare the readings by switching each one in turn into the measuring circuit and bringing the instrument into balance, Fig. 1.

2. Install a reference standard adjacent to the fixed thermocouple. Drill a hole as close as possible to the fixed

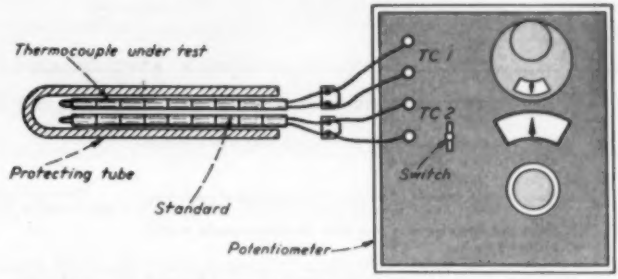


Fig. 1—Preferred method is to place both thermocouples in same tube in the heated zone, insuring the same test temperature for both units

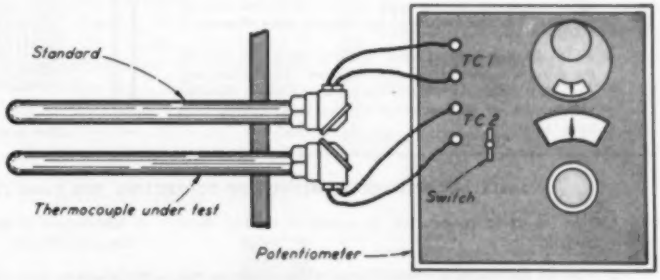


Fig. 2—Where it is necessary to use separate protecting tubes, they should be as close together as possible. Avoid temperature gradients

installation, Fig. 2, and install the standard in such a manner that the ends of the two tubes are close together. To insure a fair comparison, both thermocouples should be of the same size, and the protecting tubes of the same size and material. Connect to the instrument and read, as in Method 1.

3. Test the used thermocouple first, then replace it with the reference standard and read the temperature. The standard should always be inserted to the same depth in the protecting tube as the used thermocouple, and time should be allowed for the standard to come to equilibrium before reading.

To test an instrument, connect the same thermocouple to the portable potentiometer and the instrument under test through a double pole double throw switch, as shown in Fig. 3. Take a reading with one instrument, then switch to the other and take a second reading. Both readings should be equal.

If all the instruments in the plant use one type of thermocouple, the potentiometer can be calibrated for use with that type. In this case, the scale can be marked directly in degrees of temperature and the type of thermocouple marked on the dial. The instruments can be automatically compensated for changes in reference junction temperature by the manufacturer and no further correction need be made.

If, however, thermocouples of different types are used, an instrument calibrated in millivolts should be employed. In this case, after the emf has been determined, it will be necessary to refer to the table of temperature emf equivalents, furnished by the manufacturer of the thermocouple, to determine the temperature.

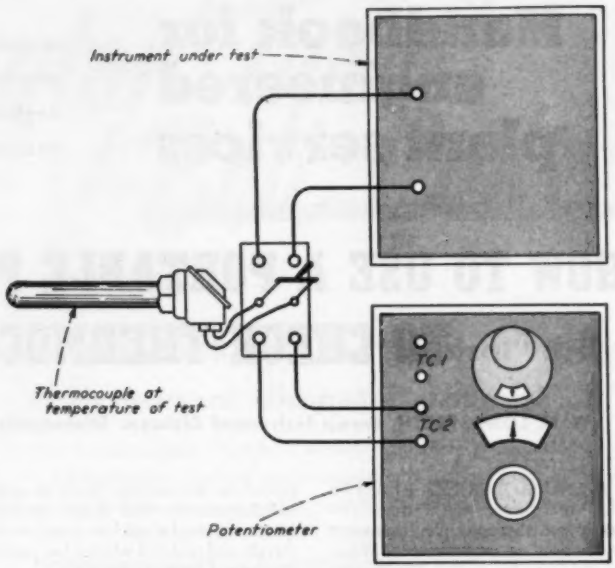


Fig. 3—Instruments normally used with thermocouples may be checked by comparing their readings with those obtained from the same source with a potentiometer. The double throw switch allows rapid change-over

Potentiometers calibrated in millivolts are not ordinarily supplied with automatic reference junction temperature compensation, and it will therefore be necessary to correct it. The two most widely used methods are given in Tables 1 and 2.

TABLE 1—FREEZING POINT METHOD OF CORRECTION FOR COLD JUNCTION TEMPERATURE

1. Insert two glass test tubes in a container filled with a mixture of cracked ice and water.
2. Place a small amount of mercury in the bottom of each tube.
3. Place one extension lead wire from the thermocouple in each of the test tubes.
4. Insert copper lead wires in the mercury in test tubes, and connect to potentiometer binding posts.
5. The emf between the wires in the test tubes is now equal to the difference in the thermocouple emf at the temperature of the measuring junction and at the freezing point of water.
6. As the freezing point of water is almost universally used as the reference point in the manufacturers' temperature emf equivalent tables, the temperature corresponding to the millivolt reading of the instrument can be read directly from these tables.

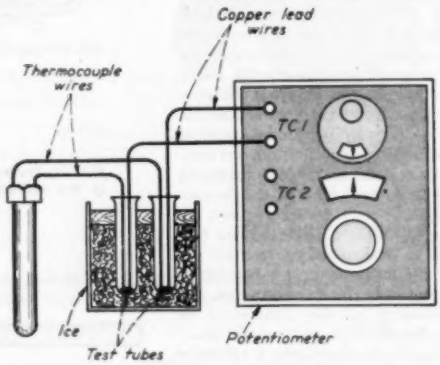
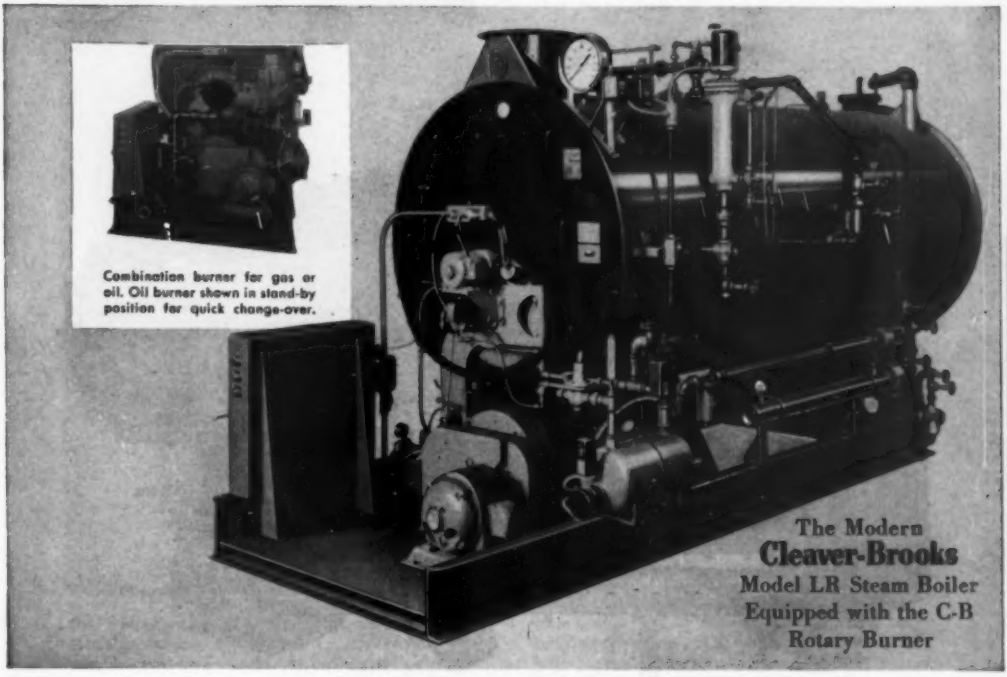


TABLE 2—APPROXIMATE METHOD OF CORRECTING FOR COLD JUNCTION TEMPERATURE

1. Note instrument temperature by means of mercury thermometer.
2. From the thermocouple manufacturers' tables, determine the emf corresponding to that temperature.
3. Add this emf to the dial reading of potentiometer after balance is obtained.
4. Determine from the tables the correct temperature, corresponding to the sum of the emf's.

unmatched Flexibility of operation ...and of quick fuel change-over


Combination burner for gas or oil. Oil burner shown in stand-by position for quick change-over.
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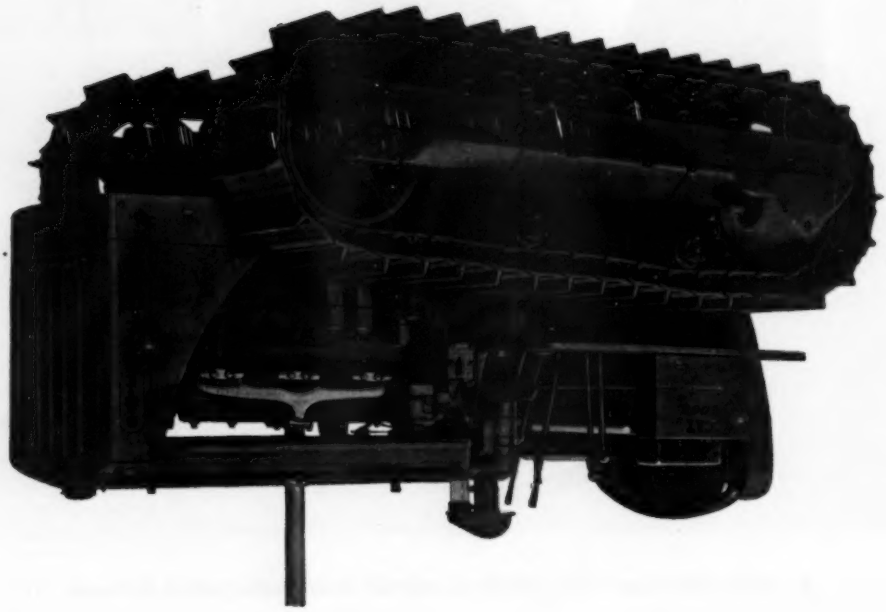
to make the feeder that



WHEN CATERPILLAR TRACTOR CO., Peoria, Ill., recently installed two* Perfect Spread Stokers at its Joliet plant it had a very special reason for confidence. The same high traction principle that has been basic to Caterpillar's own success and leadership is employed in the AE conveyor feeder . . . and this principle assures 100% uniformity of spread; *absolutely prevents clogging on wet coal!*

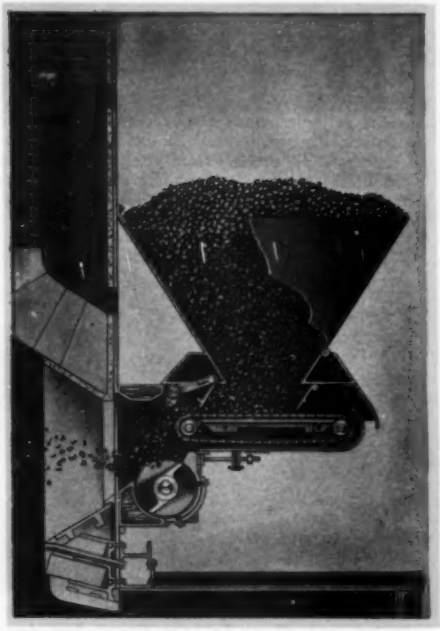
You can get Perfect Spread Stokers in a wide choice of sizes, capacities and grate types . . . but when it comes to the feeder there is only *one* choice. Every Perfect Spread Stoker is equipped with American Engineering's exclusive conveyor feeder . . . the feeder whose superiority is universally recognized and which assures true, *continuous* feeding whether operating at only 50 lbs. of coal per hour or at top capacity.

For most steam per fuel dollar, mail coupon on next page . . . today!

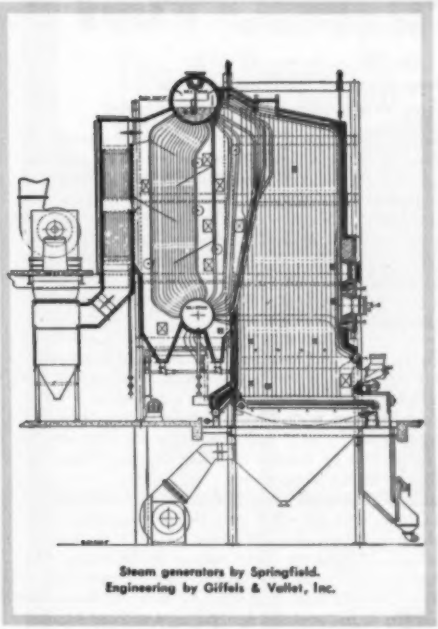
***A THIRD UNIT HAS BEEN ORDERED AND IS NOW BEING ENGINEERED.**

TOR UPSIDE DOWN

won't clog on wet coal



On Perfect Spread Stoker's traveling conveyor feeder a special mechanism drives feeder through a widely adjustable speed range – smoothly and continuously . . . Feeder unit protected against furnace temperatures by water and air cooling around furnace opening and rotor bearings . . . Special high-capacity spiral overthrow rotor distributes coal evenly over the entire grate surface . . . AE reinjection system features visible feed ejector hoppers, ejectors and nozzles of alloy iron. Complete reinjection unit serves every cinder drain point.



Steam generators by Springfield.
Engineering by Giffels & Vallet, Inc.

Cross section drawing showing arrangement of boiler components and some of the principal auxiliaries of the Perfect Spread Stoker installations at the Joliet plant of Caterpillar Tractor Co. The two boilers are designed to operate at 80,000 lbs. per hour continuously, with a peak rating of 90,000 lbs. per hour for a two-hour period. Stokers are 12' wide by 14' 3" long, center to center sprockets. Each stoker has three feeders; 171 sq. ft. total grate area with 150 sq. ft. active area; and each is operated by a 1½ hp. 1800 r.p.m. electric motor.

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☐ Also send us complete story of *Caterpillar Installation.*

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Spot news

Short, "boiled-down" paragraphs on the most interesting recent events and developments in American industrial plants

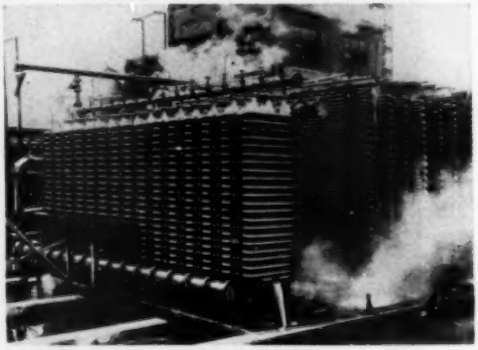
Cast Iron Cooling Sections for Use With Sea Water Have Proven Successful

Substantial operating economies are being attained in production of by-products at the Everett coke plant of Eastern Gas and Fuel Associates by progessive replacement of steel pipe coil cooling equipment with gray cast iron cooling sections. The equipment is used to cool wash oil used in the light oil recovery process, and ammonia liquor used for direct contact cooling of coal gas. In production of coke, varying quantities of light oil are obtained per ton of coal processed. Desirable products are then obtained from this oil by fractionation.

The cast iron sections offer excellent corrosion resistance to the sea water used for cooling. In addition to being close-grained, they are made with greater wall thicknesses at the turns. High thermal efficiency is also attained as a result of internal ribs and fins. The net result is more compact cooling equipment, easily maintained and costing less to operate. Pollution by leakage of contaminating fluids into the cooling water is also prevented.

Galvanized steel pipe coils had been used for cooling ammonia liquor with sea water from Boston harbor. Average life of these coils was 18 to 20 months, and constant attention was required due to leaks caused by corrosion. An initial test installation of cast iron cooling sections, manufactured by The National Radiator Co., was put in service four years ago. It has operated continuously without signs of failure and with negligible maintenance. A program of progressive replacement of 50 banks of pipe coils with cast iron sections was started in 1950, and will be completed as rapidly as possible. Each bank consists of two series stacks 15 sections high, and is designed to cool 45 gpm of ammonia liquor from 120 to 85 F, with 56 gpm of raw untreated sea water at 74 F raised to 87 F. In winter, with water temperature of 35-36 F, flow rate is reduced.

The wash oil cooler was made of Admiralty metal pipe and has given good service for 15 years. However, it is a single stage cooler and is not large enough to provide the desired final oil temperature in the summer, when wash oil temperature is reduced from 212 to 95-90 F. To gain an additional 15 degrees of cooling would require 50 per cent more surface with the same type cooling equipment,



Bank of cast iron cooling sections added to former pipe coils for wash oil at Eastern Gas & Fuel Associates

because of the closer approach to entering water temperature. A bank of cast iron cooling sections, 15 stacks each 21 sections high, was installed at one end of the original catch basin. They occupy only one-third the space required for equivalent cooling by pipe coils. They were placed in series with the older unit last year, and are cooling 29,000 gph of wash oil from 99 to 77 F when using 59 F sea water.

The Cover - Gas Line Booster Station

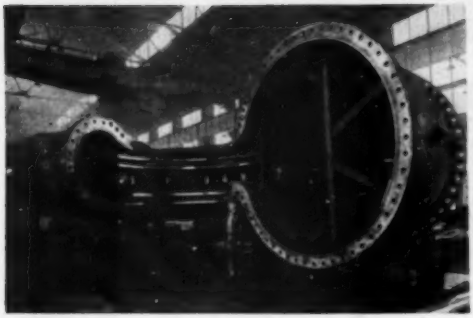
This is one of ten Cooper-Bessemer Type GMW V-angle gas engines installed at the El Paso Natural Gas Company's Keystone Main Line Compressor Station near Kermit, Texas. Eight units discharge gas at 830 psi to the main pipe line, after increasing the gas pressure from a low of 490 psi. The other two compressors are primarily boosters receiving low pressure gas from outlying fields at between 40 and 50 psi. This low pressure gas is compressed in two stages to 530 psi and discharged to the high pressure compressors. Total power developed by the ten units is approximately 15,000 hp.

Baldwin Performs Strain Gage Tests On Scroll Casing for 70,000 HP Turbine

Strain gage tests recently were made on the welded turbine scroll casing for a 70,000 hp turbine, first of two which Baldwin-Lima-Hamilton Corp. is building for the Detroit Dam power plant in Oregon.

The 130 ton turbine scroll casing is made of seven welded sections of heavy steel plate with flanges for bolting sections together. Six of these sections are shown in the illustration. Maximum diameter of the spiral is 40 ft and the opening at the large end, not shown, is 150 in.

In preparation for the tests, resistance wire strain gages were bonded by standard procedure at 17 critical points including welds, areas between welds, in fillets, and on the three-point intersection of the bolting flange, rolled plate and stay ring casting. The strength tests were per-



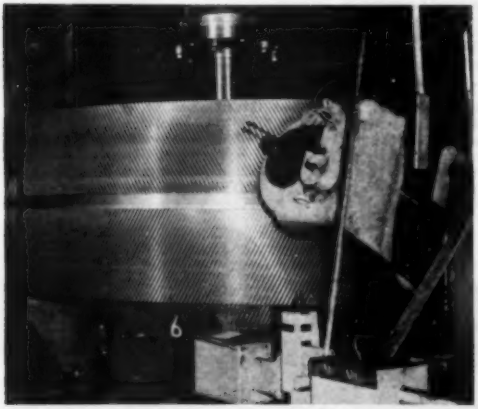
formed in conjunction with hydrostatic leakage tests. Pressures of 95, 190 and 285 psi were applied by pump and shop accumulator system. Seven strain measurements were made with each gage at each pressure. Zero readings were repeated on each measurement and found to return to within plus or minus 5 micro-in.

Westinghouse to Build Complete Atom Submarine Power Plant

The complete power plant including both nuclear reactor and associated propulsion equipment for the world's first atomic-powered submarine, the U. S. S. Nautilus, will be built by Westinghouse Electric Corp.

Previously, the company's Atomic Power Division had announced development, in cooperation with Argonne National Laboratory, of an experimental land-based nuclear reactor which will serve as the prototype of the actual submarine power plant. This experimental model is now under construction at the Atomic Energy Commission's reactor testing station near Arco, Idaho.

(Continued on page 112)



LARGE BULL GEAR IS FOR 32,000 TON TANKER

17,500 hp bull gear is being hobbed on one of General Electric's 200 in. hobbing machines at Lynn, Mass. Gear is part of equipment for two 32,000 ton tankers

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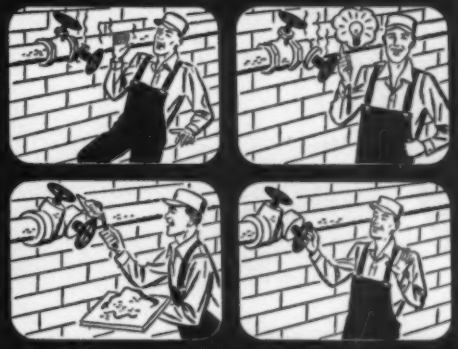

Let B-H help you reduce heat loss . . . by recommending the type of insulation best suited to *your* problems of heat control. A *complete* line of *Black* Rockwool materials—cements, blanket, block, etc.—is the basis for Baldwin-Hill's THERM-E-NOMICS® SERVICE.

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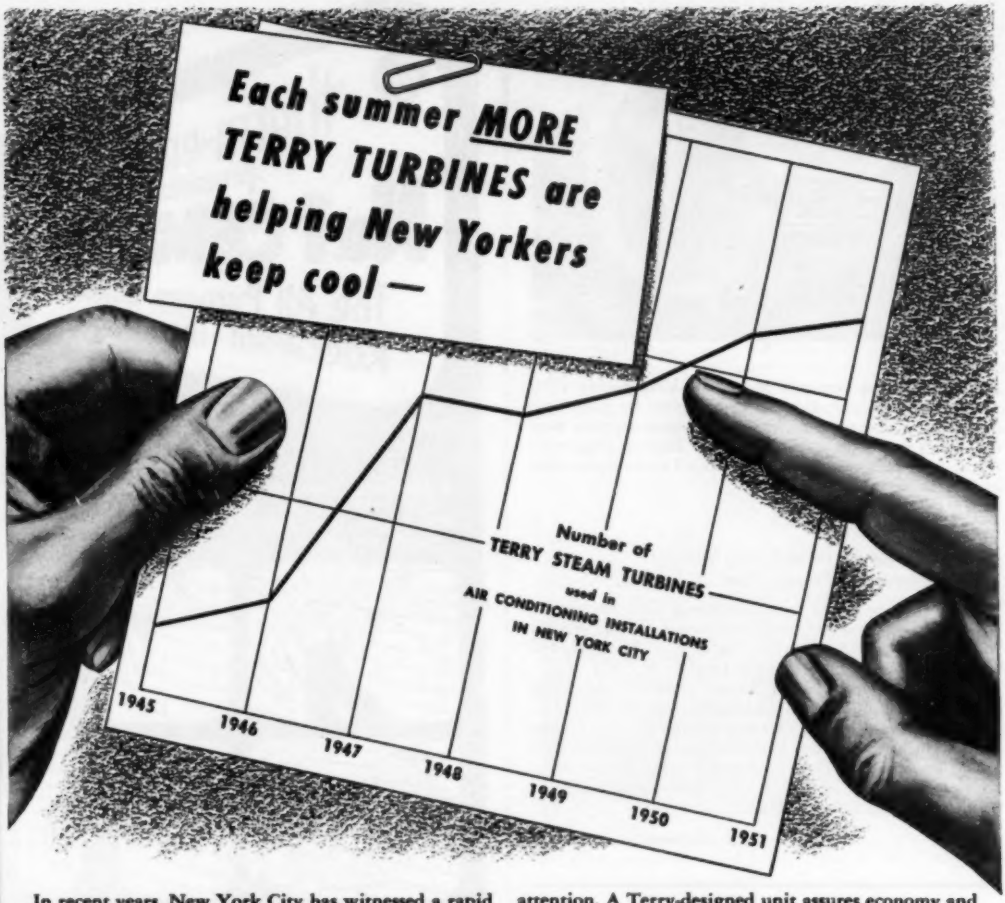

In recent years, New York City has witnessed a rapid gain in the number of air-conditioning installations providing comfort cooling by means of steam. And, as the accompanying chart shows, TERRY STEAM TURBINES have figured prominently in this relatively recent development.

TERRY TURBINES make an ideal prime mover for driving the refrigerating compressor. They respond automatically to the temperature requirements, and will cut back to as little as 15 percent of rating without attention. A Terry-designed unit assures economy and ease of operation.

Before you make a decision on your air-conditioning installation, why not call in a Terry representative? He will be glad to explain the benefits of *comfort cooling by steam.*

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For complete details on Kaylo Insulating Roof Tile, write Dept. N-310, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

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...*pioneered by* OWENS-ILLINOIS Glass Company

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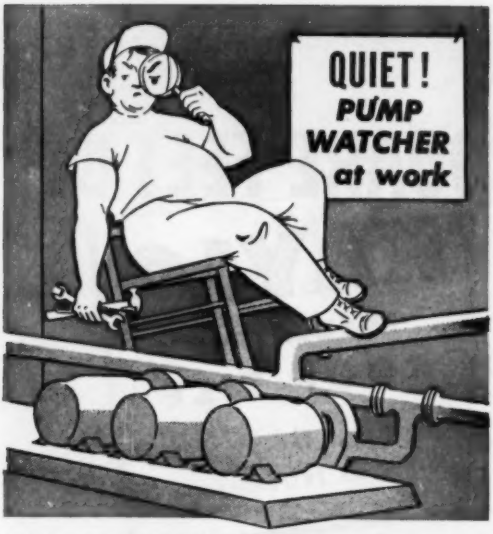

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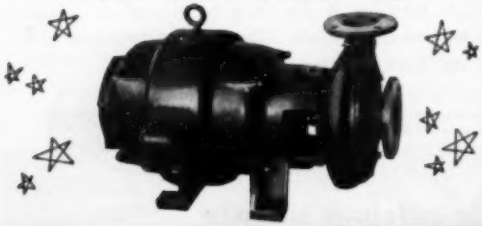
The entire WEINMAN ORGANIZATION, including your nearby representative, is anxious to put their pump experience into service for you. Every key man and department head has at least twenty-five years shirt-sleeve experience with Centrifugal pumps. Your inquiry will bring a prompt, helpful and non-obligating reply. Just write, wire or phone.

General Service Unipump for handling liquids economically and efficiently.



Built by Centrifugal Specialists

The WEINMAN Pump Mfg. Co.

286 SPRUCE ST COLUMBUS 8, OHIO

Representatives in Principal Cities

Spot news

(Continued from page 109)

Timken Installs Plastic Pipe In Two Return Wells

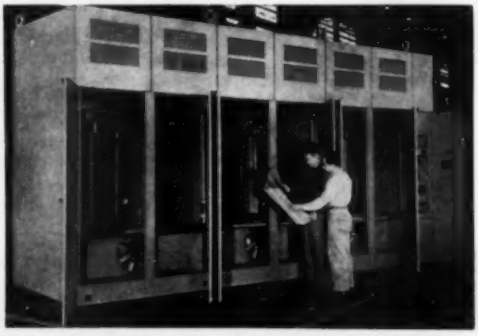
Rigid plastic pipe was recently employed in deep water wells at two Timken Roller Bearing Co. plants in Columbus, Ohio. Four deep wells, two supply and two return, provide water for several cooling processes in the plants. Each supply well is approximately 400 ft deep. Two multistage, centrifugal deep well pumps force water through factory pipe lines. Capacity of the two systems is 650 gpm. This water is discharged into open cisterns before entering the return wells.

The return wells, originally 400 ft deep, are located within 120 ft of supply wells. Warm water entering the return wells was affecting the supply and raising the temperature appreciably. To overcome the problem, the return wells were drilled to a depth of approximately 500 ft and tubed to 475 ft, with 6 in. rigid plastic pipe, manufactured by the Yardley Plastics Co. Warm return water now enters a strata below the source of supply. Due to the light weight of the pipe, installation was speedy and economical. The job was accomplished with a small well rig mounted on a 1½ ton truck.

Crete Converts Diesel Unit To Dual Fuel Operation

Conversion of a 1600 hp diesel to dual fuel operation has resulted in a 47.5 per cent reduction in fuel expenditures at the Crete, Nebraska municipal power plant. This eight cylinder, 16x20 in., 300 rpm unit drives a 1125 kw, 2400 v alternator with a 20 kw direct-connected d-c field exciter.

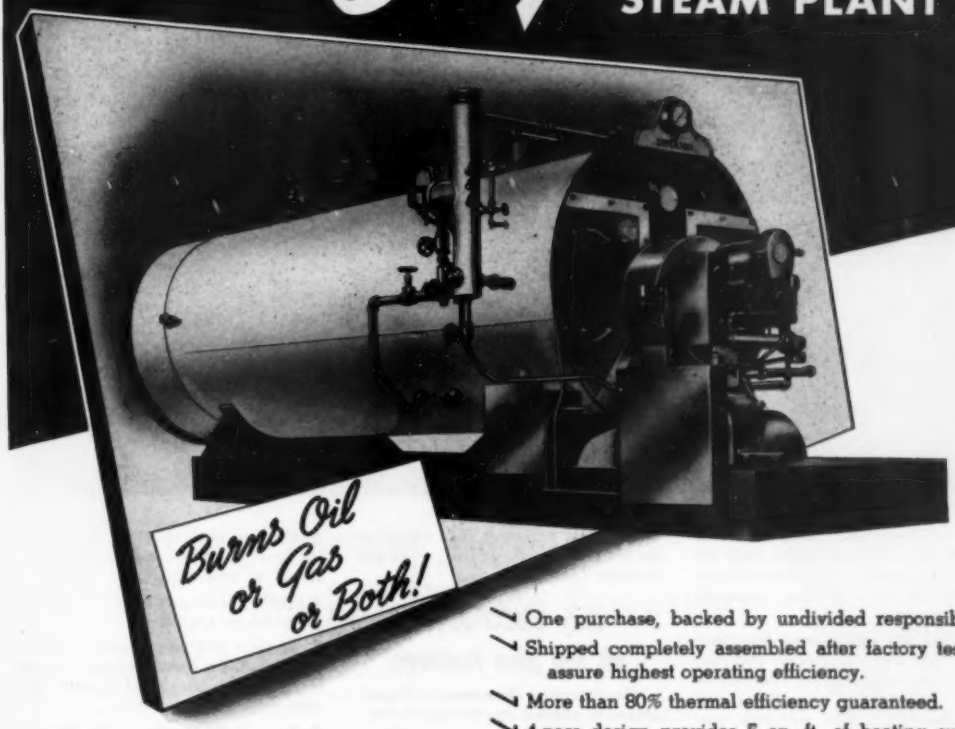
(Continued on page 116)



SUBSTATION FOR ATOMIC ENERGY PLANT

More than 600 of these 13.8 kv dry-type Westinghouse transformers are serving power distribution systems of atomic energy plants. Operating as self-cooled transformers, these three-phase units range in capacities from 200 to 7000 kva; equipped with forced-air cooling, output of the largest unit is increased to 10,000 kva

HERE'S YOUR *Complete* STEAM PLANT



- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides 5 sq. ft. of heating surface per b.h.p.
- Induced draft fans which are built-in eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Heavy-duty, rugged construction assures long-lived dependability.
- Burner equipment to suit your fuel: gas, oil or both.
- 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.
- For complete details, write today for catalog 402.

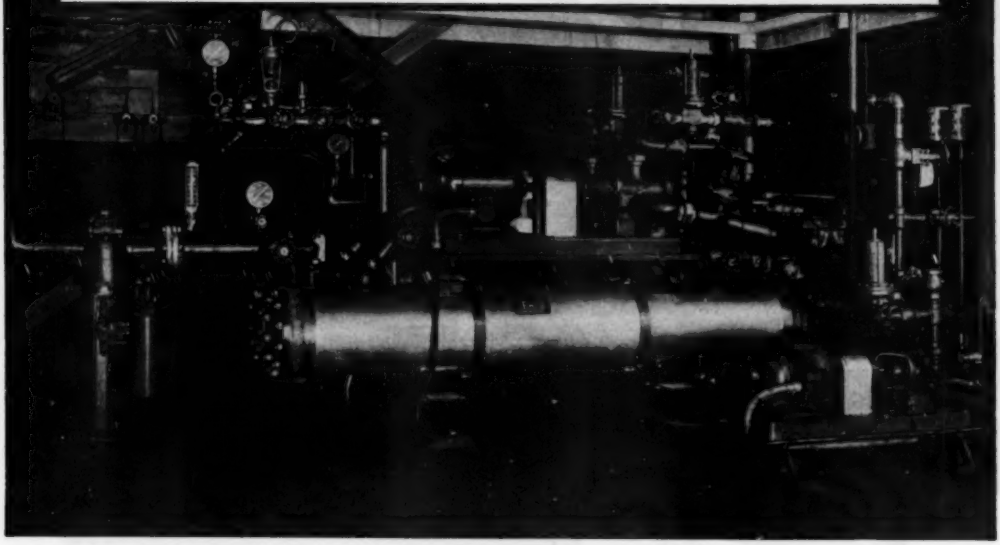
SUPERIOR STEAM GENERATORS

SUPERIOR COMBUSTION INDUSTRIES, Inc.

Factory: Emmaus, Pa.

Executive Offices: Times Building, Times Square, New York 18, N. Y.

2 separate ENCO Fuel Oil Units Meet Plant Needs



Here is a typical Enco two-unit installation which handles fuel oil pumping and heating requirements in the plant of a building materials manufacturer.

Fuel Oil Pumping and Heating Unit, built with two pumps and two heaters, is designed for continuous plant load service. Capacity is 11 gpm Bunker C fuel oil with one pump or one heater at 300 psig pressure with a temperature rise from 90F to 230F.

Light Oil Pumping Unit for cold start-up service. Capacity is 3 gpm #2 oil at 300 psig pressure.

Enco pump sets are designed to give you easier control and longer maintenance-free operation. They are simple and economical to install. All you need do is to connect to station piping and run. Before shipping, every Enco Fuel Oil Pumping and Heating Unit is completely tested under high pressures. For complete details on wide-range line, write for Bulletin O B-37.

Only ENCO offers all ten plus features

1. Completely Automatic Operation is assured by automatic temperature and pressure regulation valves.

2. Coordinated Design Saves Space. All equipment essential to the preparation of fuel oil for combustion is contained in one compact unit.

3. Individually Designed to meet the specific needs of the particular power plant in accordance with its exact operating requirements.

4. All Parts Visible and Accessible for easy operation, maintenance and repair.

5. Pumps and Heaters are interconnected to provide maximum flexibility of operation.

6. Safety Valves protect individual parts where required.

7. Easier Maintenance — Less Service-Time for Cleaning because straight tube, multi-pass heaters with removable heads are used.

8. Pumps Operate at Moderate Speed. Heaters designed to give the correct viscosity and velocity without fouling.

9. Smoother Flow of Clean Fuel to Furnace. Air chamber for each piston pump prevents pulsations—pressure regulator for rotary pumps. Twin type strainers provided to keep atomizer tips from clogging.

10. Cleaner Boiler Room . . . all overflows connected to a common outlet, flanged drip pan catches oil drip.

EC 488

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

IN CANADA: F. J. RASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34, P. Q.

"Dag" Colloidal Graphite... for Hot-Working Operations

At 500° F., and virtually as far up as you ever go in metalworking operations, **"dag"** colloidal graphite is a lubricant that does not gum up . . . that defies break-down. For brass, bronze, aluminum, magnesium, carbon steel and stainless steel . . . wherever your fabrication problems are friction and heat . . . this unusual lubricant reduces one and resists the other.

"Dag" colloidal graphite is available in dispersions designed to lubricate under all conditions of deep piercing, forging, stretch-forming, wire-drawing and ingot stripping . . . to assist in the parting of castings . . . to lubricate permanently parts that may be subject to extremely high temperatures . . . to be used in degreasing solutions which destroy ordinary lubricants.

When a **"dag"** dispersion is applied to the friction surfaces of metal it leaves a strong, durable graphoid film so thin that even the most sensitive gages cannot detect it. This lubricating film provides the metal with a surface that has an extremely low coefficient of friction . . . a lubricant that resists oxidation and functions far above the burning point of conventional petroleum lubricants.

For more information on the "Use of Colloidal Graphite for Metalworking Operations," write for Bulletin No. 426-17D.

dag DISPERSIONS®

Acheson Colloids Company, Port Huron, Mich.

. . . also ACHESON COLLOIDS LIMITED, LONDON, ENGLAND

Units of Acheson Industries, Inc.

Spot news

(Continued from page 112)

It was installed in 1947 and converted to dual fuel operation in 1950. In the first 12 months after conversion the unit operated 8703 hr, more than 99.3 per cent of the time, and generated 6,135,900 kwh.

The plant, built in 1928, now has four diesel units, all built by Fairbanks, Morse & Co. The two older diesels, now used for emergency service only, are a 360 hp six cylinder unit and a 600 hp four cylinder unit. Both engines are still in good condition and were used regularly for peak loads in the past year. The newest unit is a 1200 hp, seven cylinder dual fuel engine placed in operation in December, 1951. This 16x20 in., 257 rpm engine drives a 725 kw, 2400 v alternator with a 15 kw direct connected d-c field exciter. Total installed capacity of this plant is 2500 kw. Present peak loads are approximately 1800 kw.

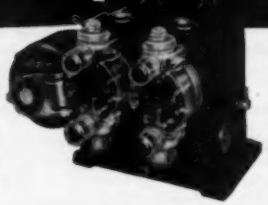
The dual fuel engines are capable of straight diesel fuel operation and in event of gas failure will immediately and automatically switch to oil without loss of load. Pilot fuel is the same as that used for diesel operation, but is supplied to the cylinder by separate injection pumps. The 28 API diesel fuel, purchased in tank car lots, is stored in steel tanks of 190,000 gal total capacity. Oil is pumped to individual 300 gal day tanks and is metered to each engine. Duplex pressure filters insure clean oil to injection pumps. Current fuel oil cost is 11.15 cents per gal delivered.

Fairbanks-Morse diesel, 1600 hp, installed at Crete, Nebraska in 1947 and converted to dual fuel in 1950

Natural gas with over 1000 Btu per cu ft is supplied to the plant at 32 psi, and is reduced to 22 psi before reaching the intake valves on the engine. Flow to each engine is measured by displacement-type gas meter. Current gas rates are approximately 28 cents per 1000 cu ft. Fuel cost on the converted dual fuel unit amounts to 4.62 mills per kwh, compared to 8.8 mills per kwh on the diesel engines, both figures being based on present fuel prices.

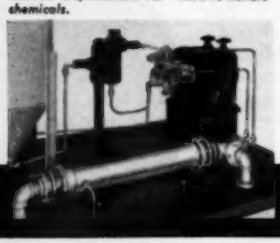
—End

CHEM-O-FEEDER All-Purpose Chemical Proportioning Pump



%PROPORTIONEERS% CHEM-O-FEEDER delivers treating chemicals in readily adjustable dosages to insure accurate, dependable control of chemical reactions. This self-contained "Package" is a low cost, trouble-free proportioner, easily installed and operated, for feeding corrosive chemicals. Chem-O-Feeder is built of standardized, interchangeable parts immediately available from stock, thus contributing materially to inexpensive maintenance. The entire mechanism operates in an oil bath and oil change is required but once a year. The Chem-O-Feeder, a diaphragm-type unit, is constructed with one, two or three measuring chambers with respective maximum capacities of ten, twenty and thirty gallons per hour at pressures up to 100 p.s.i.g. Measuring chambers are available in several plastic materials as well as metals making this feeder suitable for all commercial treating and feeding applications. Write for descriptive literature and prices. %Proportioneers, Inc.%, 357 Harris Ave., Providence 1, Rhode Island.

Indirect displacement for "hard-to-handle" chemicals.



Representative in principal cities of the United States, Canada, Mexico and other foreign countries.

TESTING TIPS

for the maintenance of plant equipment

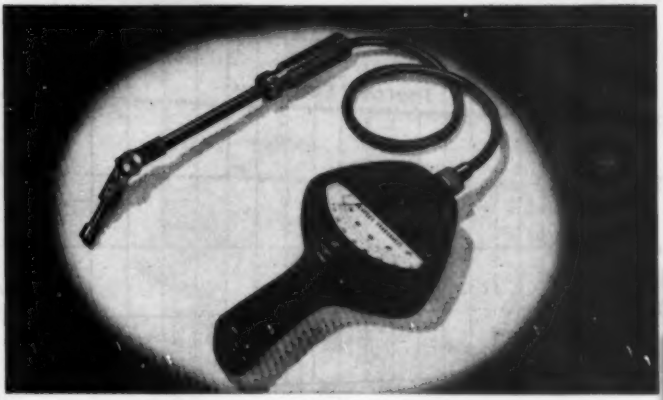
Load Studies Made Easier With CF Inkless Recorder

To plan distribution of power in your factory it is necessary to make accurate long-period circuit voltage surveys. The dependability and maximum convenience of the G-E Type CF-1 inkless recorder make it ideal for this operation. With the CF-1, one skilled electrician or engineer can supervise the power requirements for an entire plant. Records of various machines in operation can be gathered into one place for one man to analyze.

AVOID COSTLY DOWN TIME

The CF-1 will tell you whether increased schedules are overloading machines and shortening the life of your equipment. You save by avoiding costly down time and overhauls.

Available in a variety of voltage ranges the CF inkless recorder has an accuracy of 1½ percent of full-scale value—its record roll can run as long as 30 days without attention.



G.E. INTRODUCES NEW HAND PYROMETER

Single Unit With Two Scale Ranges: 0-500F, 0-1500F

Simply flick a switch to change the scales on General Electric's new Type FH-1 hand pyrometer. This unique feature cuts testing time and eliminates use of several pyrometers.

The Type FH-1 hand pyrometer is designed for rapid and convenient measurement of surface, liquid, gas and molten-metal temperatures.

THREE INTERCHANGEABLE TIPS

A surface tip, an immersion tip for liquids and molten metals, and a two-prong contact are supplied in addition to flexible and rigid extension arms—all interchangeable in seconds.

AUTOMATICALLY COMPENSATED

Readings can be made directly from either scale of the instrument, and the FH-1 has automatic cold end compensation.

STOCK SHIPMENT

See your nearest G-E representative today for complete information about immediate shipment on the FH-1, or check coupon below for GEC-836.

PLANT SUPERINTENDENT REPORTS..."With my new AK-2 hook-on wattmeter I can do this job in a quarter of the time it formerly took me with conventional instruments."

Mr. W. D. Bostwick, pictured at left, is the plant superintendent for Bramley Storage Co., Cleveland, Ohio. Bramley has a power block in Cleveland which contains 15 companies, all manufacturing widely different products. With more of these companies turning to defense production, load conditions are increasing. "We have an extensive distribution system in our plant and this AK-2 has made it possible for us to make a complete load and power factor survey quickly and accurately," says Mr. Bostwick.

With the AK-2 hook-on wattmeter, this testing job has been made easier. There is no interruption of service, you just clip the two potential leads across the line, hook the AK-2 around one conductor and take your reading in watts. The AK-2 measures single-phase and polyphase circuits with an accuracy of 5% of full-scale value. Extremely light—it weighs only 4 pounds.

SECTION D402-233, GENERAL ELECTRIC
SCHENECTADY 5, N. Y.

Please send me the following bulletins
Indicate:
√ for reference only
X for planning an immediate project

- ☐ Type FH-1 Hand Pyrometer (GEC-836)
- ☐ AK-2 Hook-on Wattmeter (GEC-591)
- ☐ Type CF Recorders (GEC-215)

NAME .....

COMPANY .....

STREET .....

CITY ..... ZONE ..... STATE .....

GENERAL ELECTRIC

402-233

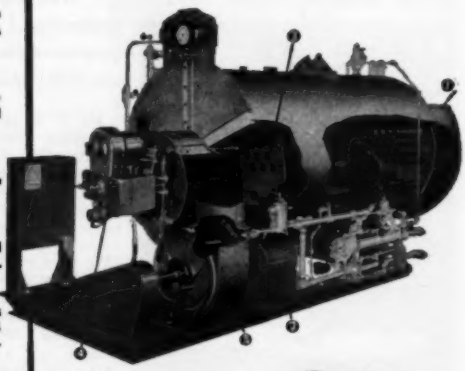
You can predict the future of a **PREFERRED** *steam generator!*

You don't need a crystal ball to predict the future of a Preferred Unit Steam Generator. Take a look at Preferred's 25-year features and you will see how the Preferred unit is designed to maintain its guaranteed efficiency for a quarter of a century . . . *with a minimum of maintenance.* You can see clearly, too, what this means in terms of year-in, year-out economy. • Here's required reading for wise investors—Bulletin 1000. Write today.

25-YEAR FEATURES*

1. Anti-stress deck for tube sheet protection.
2. Special precipitator developed by Preferred as aid to safe, clean operation.
3. Staggered tube construction—minimizes possibility of tube pitting, even at low firing rates.
4. 4700 rpm horizontal rotary oil burner with patented VOLUVALVE fuel regulation—designed and manufactured by Preferred—assures fully automatic operation even with No. 6 oil.
5. Self-cleaning induced draft fan with air cooled shaft and bearings—assures long life.
6. Down-draft gas travel for 80% thermal efficiency—proved and guaranteed.
7. Dual purging cycles for positive elimination of gas stratification.
8. 4-pass, high velocity, gas travel—minimizes tube cleaning maintenance by self-cleaning action.

* Each distinctive feature of the Preferred Unit Steam Generator is designed to give efficient, economical service for an average of 25 years, with proper care and maintenance. You benefit by better performance . . . longer life . . . lower boiler costs.

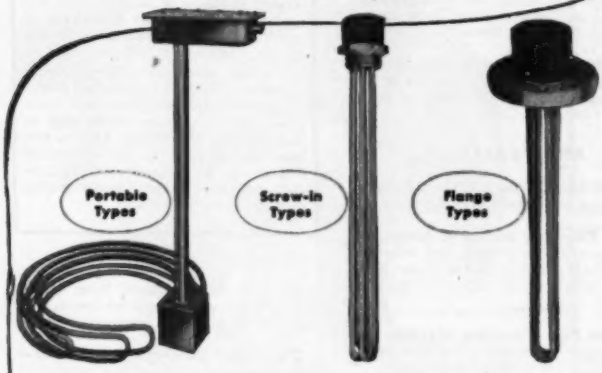


PREFERRED UTILITIES MANUFACTURING CORP.
1860 BROADWAY, NEW YORK 23, N. Y.

CHROMALOX

Electric Immersion Heaters

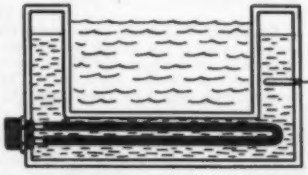
for Heating Water, Oils
Waxes, Heat-Transfer Mediums
and other Liquids



Look to CHROMALOX for Dependable Electric Heat

CHROMALOX Electric Immersion Heaters come in a full range of types for permanent or portable use. They are quickly and easily installed with minimum labor and material costs . . . and they may be manually or thermostatically controlled for accurate, care-free, dependable operation. Available in types and sizes to fit your needs in iron, steel or alloy sheaths to resist corrosion.

If you are interested in heating liquids efficiently, or if you have any other heating problem—you are invited to consult CHROMALOX.



A Typical application

Indirect immersion heating with Chromalox Electric Tubular Heaters.

OTHER UNITS AVAILABLE FOR HEATING:

Water, asphalt, greases, molten salts, pickling baths, Dowtherm, Aroclor, Prestone—for superheating steam and compressed air—for melting lead, solder, babbit and stereotype metal.

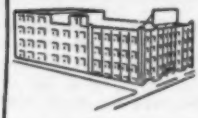
CHROMALOX

Electric Heat for Modern Industry

CHROMALOX

offers you the most
in
Electric Heat

Experience



33 years experience in electric heating, covering almost every industrial process employing heat up to 1000F°

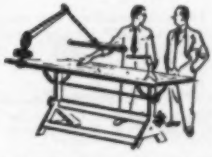
Selection

Over 15,000 types, sizes and ratings to fit most every application requiring heat.

Service

135 field engineers in 37 cities throughout the country, to give you on-the-job counsel and assistance.

Engineering



Application engineers working with research, development and manufacturing personnel provide technical know-how for solving industrial heating problems.

FOR COMPLETE INFORMATION Write for Catalog 50 which describes the complete Chromalox facilities and products designed to meet your heating requirements.

EDWIN L. WIEGAND COMPANY IC-49
7520 Thomas Blvd.
Pittsburgh 8, Pa.

Please send me a copy of the new 48 page Chromalox Catalog.

Name.....

Company.....

Street.....

City.....**Zone**.....

State.....

News
of men and companies

HONORS

American Institute of Electrical Engineers—One of the highest honors in the electrical world, the 1951 Lamme Gold Medal, has been awarded to Arthur E. Silver, retired engineering executive of Ebasco Services, Inc. The medal, which will be presented at the summer general meeting of the Institute at Minneapolis, June 23, was awarded "for his pioneering of rural electrification by designing the simplified farm-type transformer combined with high voltage, long span, and common neutral line construction."

Albert Kahn Associated Architects & Engineers—G. H. Miehls, president, was awarded honorary membership in the Michigan Society of Architects "in recognition of his distinguished service in the fields of engineering, building, and particularly to architecture and the applied arts."

Speer Carbon Co.—Dr. H. G. Mitchell has received an award for outstanding accomplishment in the advancement and application of powder metallurgy. It was presented by the Metals Disintegrating Co. on the occasion of its 35th anniversary.

SALES OFFICES

Eclipse Fuel Engineering Co.—Representatives from all parts of the country attended an annual sales meeting at the recently completed factory and office building at Rockford, Ill.

Kenco, Inc.—Announces the establishment of fifteen field service centers throughout the eastern half of the United States, with plans for more.

Midwest Piping & Supply Co.—Removed their eastern div offices to 50 Church St., New York 7, on March 1.

Quaker Rubber Corp.—Established a stock-carrying branch warehouse and sales office at 4006 Papin Street, St. Louis, Mo.

Republic Rubber Div.—Chicago, Cleveland and Memphis have been selected as sites for a series of distributors' regional meetings to be held by this div of the Lee Rubber & Tire Corp. This year's meetings are scheduled for April 17 in Chicago, April 24 in Cleveland and May 8 in Memphis.

Claude B. Schneible Co.—Opens new executive offices in Detroit at 212 Stephenson Bldg. on the corner of West Grand Blvd. and Cass.

ANNIVERSARIES

The Edwin F. Guth Co.—Celebrates its golden anniversary on April 22.

Steel Founders' Society of America—Half a century of growth and development is being highlighted in observance of the fiftieth anniversary of the society.

Toledo Pipe Threading Machine Co.—Brochure commemorating 50th anniversary now being distributed.

NEW REPRESENTATIVES

Cleaver-Brooks Co.—Announces the appointment of the Wilson-Weesner-Wilkinson Co., 310 South 2nd St., Nashville, Tenn., as a manufacturer's representative for the sale of boiler equipment. E. C. Giberson, 3719 Center St., Des Moines, Iowa, is named a manufacturer's representative for the sale of boiler equipment.

Hammel-Dahl Co.—Appointment of Cowles & Co. of Dallas, Texas, as sales and service representatives in the central Texas area is announced.

The Royalton Co.—Energy Control Co., with offices in New York, Philadelphia, Baltimore, Wilmington, Harrisburg, Newark, North New Haven and Albany, will be representatives for the sale of pipe line expansion joints.

The Vapor Recovery Systems Co.—Two new sales agencies are appointed. Arduser & Co., P. O. Box 4267, Tulsa 9, Okla., will service the Oklahoma and northeastern Texas area, Kansas and Nebraska. Paul B. Mueller Co., 1033 Metropolitan Life Bldg., Minneapolis, Minn., will serve the North Dakota, South Dakota, Minnesota and western Wisconsin area.

EXPANSIONS

Diamond Alkali Co.—Awarded contracts to The H. K. Ferguson Co. to engineer and construct facilities for a major expansion of chlorine production at the Painesville, Ohio plant.

Bacharach Industrial Instrument Co.—Has entered the diesel service tool field through the purchase of all inventories and production facilities of Curtiss & Smith Mfg. Co., Pottstown, Pa.

BullDog Electric Products Co.—Announces that it has added two branch plants to its facilities. The first plant, located in Urbana, Ohio, is part of BullDog's Ohio subsidiary along with operations at Bellefontaine. The second is in Detroit and is a branch of the main factory at Joseph Campau Street in Detroit.

E. I. Du Pont de Nemours & Co., Inc.—Plans for construction of a $2 million Haskell Laboratory of Industrial Toxicology near Newark, Del., were announced.

Hewitt-Robins, Inc.—Recently completed arrangements for the acquisition of two additional plants—the Korb-Pet-

(Continued on page 122)

FOREIGN SOCIETIES TO PARTICIPATE IN CENTENNIAL OF ENGINEERING

First indication of the worldwide scope of the Centennial of Engineering to be celebrated in Chicago this summer was given in an announcement by its president, L. R. Lohr, that the leading scientific societies of seven foreign nations have pledged active participation. These are in addition to the 49 American scientific and engineering bodies already announced.

One of the largest foreign delegations will be that of the Royal Society of Industrial Engineers of Belgium which will send 11 delegates. Other countries to be represented include Japan, Great Britain, Mexico, and Canada.

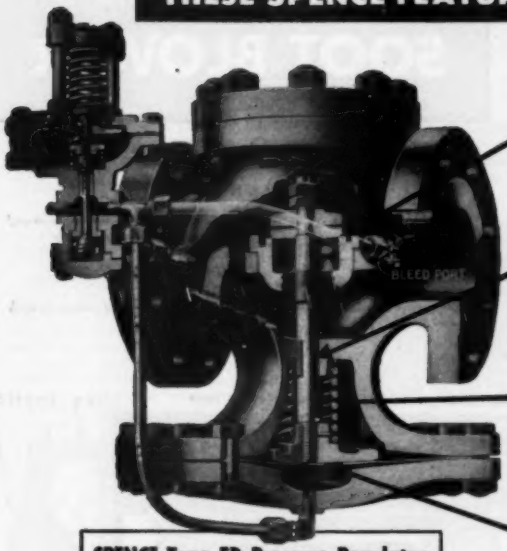
It is also stated that other prominent engineering bodies in Norway and France are definitely pledged to participate. European engineering societies, as well as those of Latin and Central America will have leading parts in the ceremonies planned for the International Day program, scheduled to open the convocation meeting on September 3.

Cities Service industrial heat prover, an instrument used for measuring the combustion efficiency of a furnace, is explained to a group of combustion specialists from England by W. W. Scheumann, Cities Service executive. Members of the visiting British group are (l to r) E. G. Ritchie, W. L. Boon, L. C. Watts and W. S. Hudson

HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. More than twenty years of experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

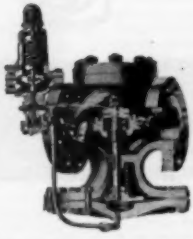
SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

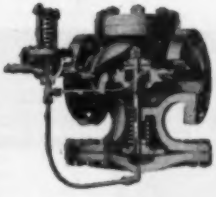
YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.

Type BT150 Temperature Regulator—Tops in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

These Companies Have Profited with SPENCE!

The Springs Cotton Mills
Ford Motor Company
Pennsylvania Power & Light Company
Jones & Laughlin Steel Corporation
National Tube Company
The Atlantic Refining Company
Great Lakes Steel Corporation
Todd Shipyards Corporation
Land O'Lakes Creameries, Inc.
General Electric Company
R. J. Reynolds Tobacco Company
Ohio Edison Company

and thousands of others

SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

Spence

MECHANICALLY OPERATED VALVE Improves Performance

The valve now being used on Diamond Model IK Long Retracting Blowers is actuated mechanically by the carriage that projects and retracts the lance tube . . . as shown by the photographs at the right. Opening and closing of the valve is positive . . . dependable . . . accurate.

Note the simplicity of the mechanism. Ample adjustment is provided to permit valve operation to be set at the proper point for each individual blower. This valve has very low pressure drop and is suitable for either steam or air blowing; it has the exclusive Diamond adjustable pressure control unit for selection of blowing pressure to meet individual blower needs. This mechanically operated valve has been in field operation on many IK Blowers in severe central station service for the past two years. Results have been so satisfactory that it is now standard on IK Blowers.

OF DIAMOND MODEL IK LONG RETRACTING SOOT BLOWER

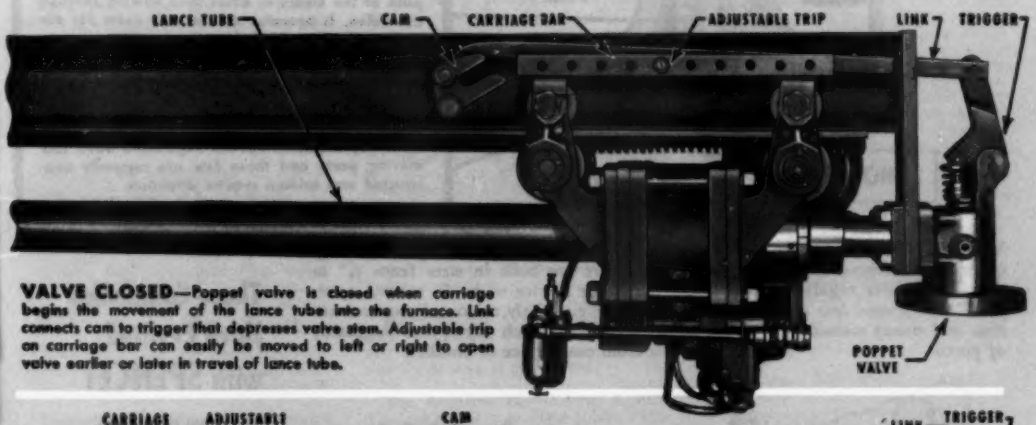
ADVANTAGES

- Positive valve action
- Simple and rugged mechanical linkage
- Adjustable valve operating position
- No critical adjustment for tight valve seating
- Completely adaptable to steam and air blowing, interchangeably
- Low pressure drop
- Adjustable pressure control on each individual blower

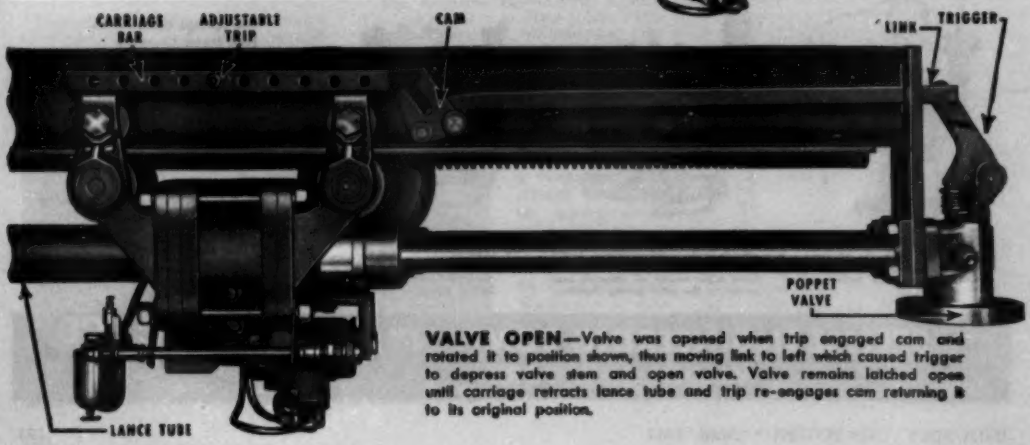
DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

Diamond Specialty Limited • Windsor, Ontario



VALVE CLOSED—Poppet valve is closed when carriage begins the movement of the lance tube into the furnace. Link connects cam to trigger that depresses valve stem. Adjustable trip on carriage bar can easily be moved to left or right to open valve earlier or later in travel of lance tube.



VALVE OPEN—Valve was opened when trip engaged cam and rotated it to position shown, thus moving link to left which caused trigger to depress valve stem and open valve. Valve remains latched open until carriage retracts lance tube and trip re-engages cam returning it to its original position.

News

of men and companies

(Continued from page 120)

tit Co. of Philadelphia, manufacturer of wire fabric screen cloth, and Micro Engineers, conveyer machinery manufacturer in Johannesburg, South Africa.

The Schaible Co.—Purchased a large plant in Mariemont, Ohio, for $1 million. The plant was formerly owned by Emery Industries, Inc. The building has 140,000 sq ft of floor space and is on a tract of land covering six acres.

Southern States Equipment Corp.—Plans have been completed and construction started on a one story building to join the present facilities. The new addition will be a steel and masonry structure covering approximately 25,000 sq ft.

Westinghouse Electric Corp.—Transformer Div. reports that production of Hipersil wound cores for electronic transformers begins the first of March at two recently leased plants in Greenville, Pa., and Lima, Ohio. The move will release approximately 30,000 sq ft of space for the production of distribution transformers at the main plant at Sharon, Pa.

APPOINTMENTS

Allis-Chalmers Mfg. Co.—Retirement of F. Nagler, mgr and chief engineer of Allis-Chalmers atomic power section, effective March 1, is announced. C. R. Gibbs is named asst supvr of mechanical service and erection. Assignment of J. C. Barnett, N. W. Morelli and E. R. Perry as asst engineers at the Boston Works is announced.

The Hays Corp.—Named P. Sprague, Jr. executive v-p and announced ap-

P. Sprague, Jr. P. B. LeBoeuf

pointment of P. B. LeBoeuf to succeed Sprague as advertising mgr.

Atlas Chain & Mfg. Co.—Announces the appointment of F. Ingham as Cleveland mgr.

Baldwin-Hill Co.—Appointment of P. A. Bell as district mgr industrial sales in the New England area is announced. He will operate from the sales office located at 500 Fifth Ave., New York 18.

Alloy Steel Products Co., Inc.—Appointment of W. P. Simmons as sales representative for the western territory is announced. He will cooperate closely with the Republic Supply Co. of California, authorized distributor for Aloyco valves. Headquarters will be at 24 California St., San Francisco.

Blaw-Knox Co.—Announces that O. G. Schwenk is named v-p in charge of industrial products. A. A. Levison is named v-p and genl sales mgr of the Blaw-Knox Div. Announcement also is made that H. R. Loxterman is appointed asst genl sales mgr of the Blaw-Knox Div. In addition to his new duties, he will continue as mgr of the steel plant equipment dept.

Enterprise Engine & Machinery Co.—To meet the needs of expanding sales, former chief engineer, J. H. Sheusner, becomes head of engineering

J. H. Sheusner L. O. Mjolsnes

and manufacturing for this div of General Metals Corp. L. O. Mjolsnes takes over as chief engineer. New sales personnel in the diesel engine div include R. Hogaboom, district mgr of the Los Angeles branch, with C. Carmichael, sales engineer, added to the branch office staff in Chicago. D. J. O'Leary and S. F. Atsatt are sales engineers assigned to the San Francisco office.

BullDog Electric Products Co.—B. O. Beckley is appointed Cleveland district mgr replacing H. Leavell who has retired. F. R. Snider is assigned the Pittsburgh territory replacing J. Audet who has retired. D. E. Aberdeen is added to the Chicago sales force, reporting directly to A. L. Burleigh, Chicago district mgr. R. B. Culbreth is assigned to the Atlanta, Georgia, office, reporting to E. R. Boruch, southern div mgr.

The Philip Carey Mfg. Co.—H. C. Mears is promoted to asst sales mgr of the industrial insulation dept.

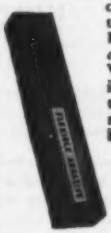
General Electric Co.—J. C. Helies is appointed genl mgr of the newly established appliance control dept. W. A. Raines is named asst mgr of the industrial dept, New York district, of the Apparatus Sales Div., succeeding the late L. F. Rodewig, who died in February. H. T. Todd succeeds Raines as head of the general sales section. Concurrently the appointment of W. E. Graham to head the section on machinery manufacturer sales is announced. Four appointments in the meter and instrument dept at Lynn,

(Continued on page 124)

NEW IDEAL FLEXIBLE ABRASIVE

- Cleans Commutators
- Gives Burnished Finish to Commutators After Grinding

The perfect tool for use following grinding or using a regular Resurfacer on the commutator. Made of a fine grain abrasive material held together by a flexible bond. It's gentle, fast action quickly removes surface imperfections with minimum cutting . . . Used as a commutator cleaner it quickly removes high resistance film, dirt and grease. Cleans like an eraser and generates very little dust—wears down slowly without "gumming" or dusting. Does not affect the face of the brush or cause filling of commutator slots. Non-conductive and non-loading — can be safely used with motors or generators operating. *Will not scratch or score commutators or rings . . .* Very easy to use. Just hold it against the face of the turning commutator or slip ring. FIVE SIZES — Order by Catalog number.



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82-002	⅛ x ¾ x 5
82-003	⅛ x 1 x 5
82-004	1 x 2 x 5
82-005	1 x 4 x 5

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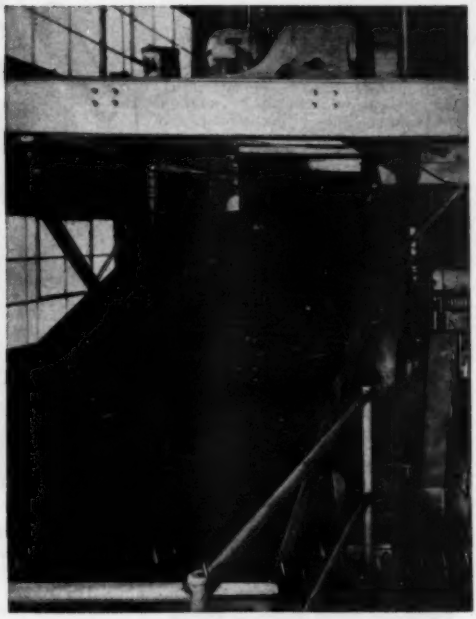
HEWITT-ROBINS



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VIBRATING SCREENS

Whatever your screen—from 9,000 lb. boulders to millimeter fractions—Hewitt-Robins has a vibrating screen to match your needs!

Take your choice. Hewitt-Robins originated both the circle-throw and the elliptical throw principles. We make units with 2 and 4 bearings, positive or unbalanced vibrator, with one or multiple decks, in sizes from 16" x 36" to 72" x 192", floor mounted or suspended, inclined or horizontal. With or without electrically heated cloth, ball tray decks, dust enclosures, hoods, collecting decks and other special features.

Don't take chances. Get genuine Hewitt-Robins screens . . . the screens backed by more experience, more knowledge, more successes than any other make.

Tell us your problem.
We will give you the correct answer.

HEWITT-ROBINS INCORPORATED

Stamford, Connecticut

News

of men and companies

(Continued from page 123)

APPOINTMENTS

Mass. are announced. D. E. Craig is named mgr of the Somersworth, N.H., plant; J. C. Garrett, acting mgr of marketing for the dept; L. P. Hannaway, asst to the mgr of marketing; and J. E. McQuillan, mgr of marketing services.

Chiksan Co.—H. J. Hagn has been elected president and a director, it was announced following a recent meeting of the board of directors. W. E. Spear, former president, has been advanced to

J. H. Robinson **H. J. Hagn**

chairman of the board, and J. H. Robinson has been elected a v-p of Chiksan Co. and appointed genl mgr of Well Equipment Mfg. Corp., a division. G. M. Bagnard has been appointed chief engineer replacing D. C. Warren who is returning to his native state of Texas.

Cox & Co., Inc.—Election of H. M. Brusman as v-p in charge of sales is announced.

Diamond Chain Co., Inc.—Announces appointment of D. G. Visknisklki as Chicago dist mgr. He succeeds S. C. Hurley, who is retiring.

General Controls Co.—W. M. Roecker is named mgr of the Cleveland branch office.

Hagan Corp.—D. E. Dixon, former power and maintenance engineer for various Colorado municipal and industrial power plants, is named service representative in the Denver district.

Hall Laboratories, Inc.—Assuming new responsibilities, J. N. Welsh, associate director, now will handle all service contracts and other business activities.

Illinois Institute of Technology—Dr. R. G. Owens is named dean of engineering replacing Dr. J. T. Rettaliata who recently was named president.

Link-Belt Co.—R. S. Wood is named genl mgr of the ball and roller bearing plant (Dodge plant) in Indianapolis, succeeding C. V. Loughery who has retired after 50 years' service at the Philadelphia and Indianapolis plants. W. R. McNally is now representative for the

pulp and paper industry, succeeding H. F. R. Weber, who has resigned and is now living in Florida.

The Manufacturers Light and Heat Co.—H. R. Weitzel is named supt of natural gas compressor stations succeeding M. L. Cowden who retired March 1 after 35 years' of gas company service.

Goodyear Tire & Rubber Co.—A. G. Buckley is appointed asst mgr of construction engineering, with headquarters in Akron. A. J. Gracia, who has been affiliated with the office of the v-p, is named asst mgr of research and development activities.

The post left vacant by Gracia's promotion is filled by J. D. D'Ianni, previously in charge of research studies on synthetic rubbers and vinyl plastics materials. Other assignments listed are those of H. J. Osterhof as director of research; and W. W. Vogt, development mgr of the Tire and Compounding Div. Working under Dr. Osterhof's direction at the research laboratory are A. M. Clifford, mgr of organic research; J. A. Merrill, mgr of engineering research; and H. A. Endres, mgr of rubber and plastics research.

Iron Fireman Mfg. Co.—J. W. Coffman, partner in Coffman Brothers, Iron Fireman dealer at Evansville, Ind., is appointed industrial sales supervisor in the central region. He will work out of the company's regional office at Indianapolis.

Johns-Manville Corp.—Appointment of M. W. Burleson as asst mgr for the insulation dept, Industrial Products Div., is announced.

Combustion Engineering-Superheater, Inc.—Announces the election of W. J. Vogel and R. M. Hatfield as v-ps. Vogel also will continue as chief engineer

W. J. Vogel R. M. Hatfield

working in association with W. H. Armacost, v-p in charge of engineering. Hatfield will continue as mgr of the western div with headquarters in Los Angeles.

The Permutit Co.—M. E. Gilwood is now director of research. He will be responsible for all operations of the research, analytical and pilot plant laboratories at Birmingham, N. J., and for market research activities from his office in New York.

%Proportioneers, Inc.%—At a recent annual meeting of the stockholders, the following were elected to the board of

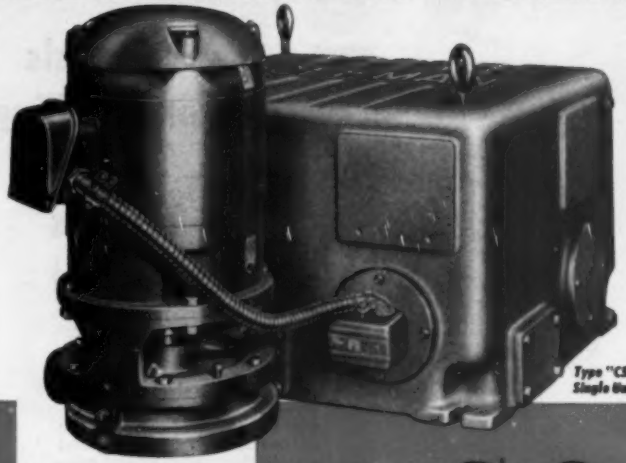
(Continued on page 128)

ANNOUNCING!

HOFFMAN

NEW IMPROVED CLOSE-COUPLED

CONDENSATION PUMPS



Type "CS" Single Unit

THESE FEATURES ASSURE YOU THE MOST MODERN PUMP AVAILABLE

1 Bronze fitted throughout.
2 Enclosed, precision balanced bronze impeller.
3 Stainless steel impeller hub.
4 Renewable bronze wearing ring.
5 Split bronze packing gland.
6 Drain plug for impeller casing.
7 Standard ball bearing motor, 40°C continuous duty, with ample overload capacity.
8 Heavy cast iron receiver.
9 Heavy duty float control, seamless copper float and brass rod.
10 Impeller has top suction inlet—eliminates air or vapor binding.
11 No piping between pump and receiver.
12 Float switch adjustable to various water levels.
13 Rigid motor support, very quiet.
14 Threaded outlet on pump cover to provide drainage and eliminate base with drip lip.

Type "CD" Duplex Unit

Hoffman, an old name on pumps, is proud to present a completely NEW line of Close-Coupled Condensation Pumps in single and duplex units!

Not only are these compact Hoffman Pumps recognized as highly efficient units, but they have design features which amazingly prolong service life, at low upkeep cost. They are so constructed that all parts subject to wear can be easily renewed. All cast iron and bronze construction.

Series "CS" and "CD" Pump capacities range from 1,000 to 150,000 sq. ft. EDR. Discharge pressures range from 10 lbs. per sq. in. to 60 lbs. per sq. in.

All together, these pumps are a rare combination of sound design and excellent workmanship. Units are shipped ready for connecting to the system.

FOR SMALL SYSTEMS THE "WATCHMAN NO. WC 8-20" PUMP for low pressure heating systems. Rating: 500 to 8000 sq. ft. EDR. Pump Capacity: 12 gallons per min. Pressure: 20 lbs. per sq. in. at pump discharge. ½ HP Standard Home motors.

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Makers of Vidrex, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems.
Sold by leading wholesalers of Heating and Plumbing Equipment.

UNIT RESPONSIBILITY

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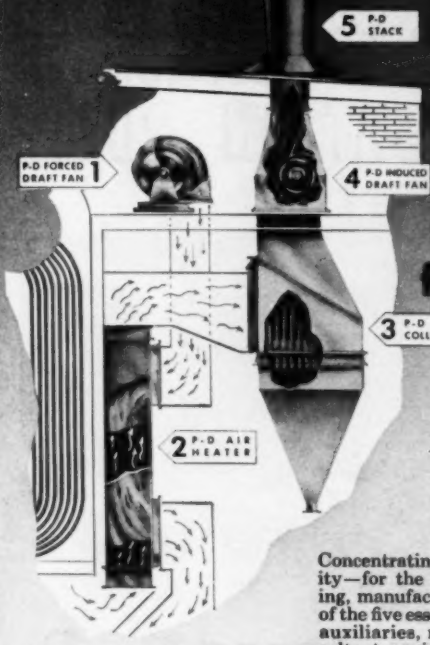

the 5 essentials for handling the air-gas stream

Concentrating the responsibility—for the design, engineering, manufacture and delivery of the five essential boiler plant auxiliaries, relieves the consultant engineer and general contractor of this problem.

The Thermix Corporation, project engineers for Prat-Daniel equipment are glad to offer you their wide background in the proper application of (1) P-D Forced Draft Fans; (2) P-D Air Heaters; (3) P-D Tubular Dust Collectors (standard Valmont and Decantation); (4) P-D Induced Draft Fans; (5) P-D Fan Stacks.

Your over-all plan is simplified when the complete responsibility for the production and control of gas is placed with P-D, a firm known to the Utility and Power fields for over a quarter of a century. This unit responsibility means less details for you.

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News

of men and companies

(Continued from page 125)

APPOINTMENTS

directors for a period of one year: R. P. Lowe, H. S. Chafee, E. H. Bradley, R. H. Glanville, E. F. Pickering and C. G. Haire. The following were elected officers of the company for one year: R. P. Lowe, president; E. H. Bradley, v-p & secy; R. H. Glanville, v-p; H. S. Chafee, treas; B. C. Greenough, asst treas & asst secy; L. M. Bullock, asst treas; C. G. Haire, asst secy.

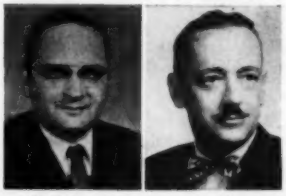
The Cooper-Bessemer Corp.—Combined regional office and warehouse has been established at New Orleans under the direction of T. E. Kraner, branch

T. E. Kraner F. A. Gehres

mgr. The new facilities now provide direct factory representation for all engineering service requirements on engine and compressor applications. F. A. Gehres is asst branch mgr.

Quaker Rubber Corp.—This div of H. K. Porter Co., Inc. promotes J. R. Lewis to genl sales mgr.

Dollinger Corp.—The appointment of two new district representatives is announced. S. E. Baum, Dixie Engineer-Co., Birmingham, Ala., is named district representative in Alabama, Western



S. E. Baum R. A. Stipp

Florida and Marion, Hamilton, Bradley and Polk Counties, Tennessee. R. A. Stipp of Greenville, S. C. is appointed district representative for North and South Carolina, and Eastern Tennessee.

Raybestos-Manhattan, Inc.—Appointment of G. S. Himebaugh as mgr of distributor sales of the western sales district, Manhattan Rubber Div. is announced. He succeeds R. B. Hazard,

recently appointed sales mgr of the Packing Div.

Toledo Pipe Threading Machine Co.—J. L. Emch is the new sales representative in the area including Missouri, Kansas, Colorado, Nebraska, North Dakota, South Dakota, Iowa, and Cheyenne and Casper, Wyoming. He will make his headquarters in Kansas City. H. W. Sabin is named the new sales representative in the area including Washington, Oregon, Montana, Idaho, Utah, Wyoming, and Vancouver and Victoria, B. C., Canada. Headquarters will be in Seattle.

Worthington Pump & Machinery Corp.—Announcement is made that A. L. Jones is appointed mgr of the Water Treating Div. Formerly mgr of the sale of water treating and deaerator section of the Steam Power Div., he will now be in charge of sales, engineering, production and service of water treating equipment. C. K. Hood is elected to a vice presidency. He will be responsible for the direction of the activities of the Public Works, Steam Power, Deaerating, Water Treating, and Steam Turbine Divs. and will report to T. Cruthers, v-p. W. J. Van Vleck, present mgr of the Atlanta district sales office, will succeed Hood as mgr of the New York district sales office.

Sterling Electric Motors, Inc.—Opening of a new district office in Denver, Colo. and the appointment of J. R. Hughes as district mgr is announced. The new office is located at 1726 Champa St. Another recently opened sales office is in New Orleans at 12 San Jose Ave. J. D. Trice is mgr of the new office.

J. D. Trice J. R. Hughes

OBITUARIES

The Airetool Manufacturing Co.— E. K. Ingalls, eastern representative, died unexpectedly on January 22, 1952.

General Electric Co.—J. H. Crawford, sales consultant for the Construction Materials Div., died March 6 at Bridgeport.

The M. W. Kellogg Co.—M. W. Kellogg, 79, founder and chairman of the board, died at his home, 810 Fifth Ave., New York City, on February 22.

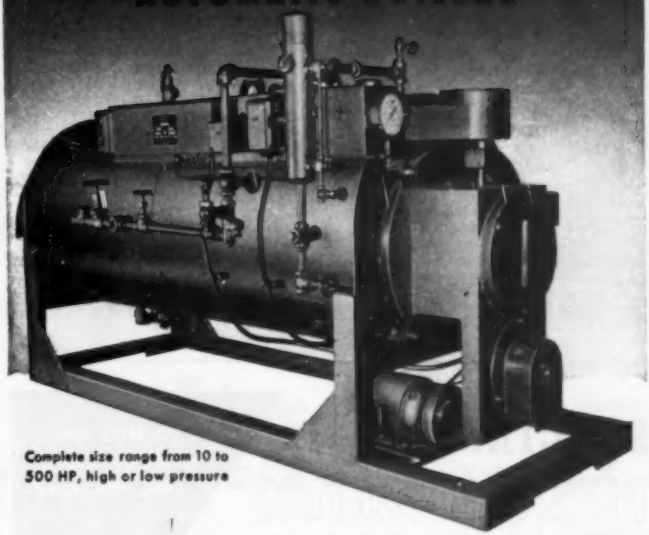
Worthington Pump & Machinery Corp.—J. R. Williams, 57, product mgr of pavers and portable mixers at the Dunellen, N. J. plant died Feb. 1.

End

Steam at low cost

Continental

PACKAGED AUTOMATIC BOILERS



Complete size range from 10 to 500 HP, high or low pressure

Savings you make with a Continental Packaged Automatic Boiler rapidly repay your initial investment. First, you save on installation. The unit is factory assembled and tested, ready to operate after simple service connections in your plant. Second, you save on fuel. The Continental operates with guaranteed efficiency of at least 80%. Independent tests prove the steam generated contains less than 1% moisture.

Of proven design, this boiler requires no furnace refractory. The fuel is burned in a furnace entirely surrounded by water, and the gases pass spirally through the tubes, giving maximum heat transfer, low flue gas temperature, and high efficiency.

Third, you save on maintenance. Replacement of cracked refractory is eliminated and boiler front and back can be opened in 15-20 minutes, simplifying cleaning and servicing. Many users report these and other major savings with the Continental in heating and processing.

The unit is completely automatic and equipped with efficient burners for heavy oil, light oil, gas, or a combination. May we send you literature that fully describes it?

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DISTRIBUTORS—PLEASE NOTE: A few choice territories are open. Request details on your company letterhead.

Reviews of recent books . . .

Recent books, published for men responsible for the Engineered Plant Services, are reviewed here. Write to the publisher for those in which you are interested

Acoustic Standards

"American Standard Acoustical Terminology, Z24.1-1951", American Standard Association, 70 East 45 Street, New York 17, N. Y. Price $1.00

How does factory noise affect the worker—how can it be diminished—at what point does it have a depressing effect upon the worker? These are questions answered in this book. Terms such as threshold of audibility and feeling have been completely revised to bring them into agreement with the most recent experimental results.

Enormous use is being made of acoustical concepts in industry, and this has been taken into consideration in the standardization of the term "mel" as a unit of pitch and "sone" as a unit of loudness. Using these two units, the decrease in the amount of noise in a given room can be calculated on an arithmetical instead of a logaritchmic scale.

Terms discussed in this section are: pitch, loudness, loudness level, phon, loudness contours, auditory sensation area, level above threshold, masking, air conduction, audiogram, masking audiogram, difference limen, aural harmonic, electrophonic effect and others.

Pipe Stresses

"Piping Stress Calculations Simplified" by S. W. Spielvogel. Published by S. W. Spielvogel, Lake Success, N. Y. 114 pages, illustrated with drawings and contains useful tables. Price $4.50

This is the fourth printing of this useful handbook and contains complete information on how to calculate stresses in pipe lines. Considerable space has been given to the exploration of the stresses in pipes under changing temperatures. The book is arranged for quick reference to formulas involved in specific cases, without reviewing theoretical background.

Specific instruction reduces the probability of error through omission of detail. Computation forms are arranged to permit sharing of labor on three-dimensional piping systems by allocating parts of the work to several persons. This book brings the layout problem well within the grasp of the layman who wishes to obtain practical answers to piping systems.

SPECIALISTS in PIPE FABRICATING

TO MEET THE MOST EXACTING SPECIFICATIONS

Butt Welds • Bending All Types • Coiling Machining • Threading • Beveling • Lining Pickling • Galvanizing • Sand Blasting • Preheating • Stress Relieving • Testing.

PIPE—Wrought Iron—Steel • Structural Cast Iron Copper Steel • Seamless • Electric Weld Spiral, Lap Butt Weld • Shore Dredge • SPEED-LAY.

PILING—Sheet piling, lightweight —Tubular—all size.

PILE FITTINGS—All types and sizes for steel and wood.

For Oil, Chemical, Concrete, Asphalt and other Industrial Requirements, ALBERT "Rings the Bell."

ALBERT PIPE SUPPLY CO.

BERRY AT NORTH 13th STREET BROOKLYN 11, N. Y.

Industrial Films

Corrosion

The Corrosion Engineering Section of The International Nickel Co. has prepared a sound-color film entitled, "Corrosion in Action". It shows how corrosion works to cause an annual loss in industry and elsewhere estimated at over six billion dollars and how this damage can be avoided or controlled by various means, such as by the selection of corrosion-resistant materials, by the development of new alloys to meet given situations, by the use of electric currents to provide cathodic protection, and by other methods.

"Corrosion in Action" was made essentially for technical, educational and industrial groups, though its treatment is such that it can be understood by non-technical audiences and is available for immediate release. Bookings can be made through the Corrosion Engineering Section, The International Nickel Co. Inc., 67 Wall Street, New York 5, N. Y.

Productive Maintenance

Augmenting its recently announced Productive Maintenance Program, GE now offers a 12 min black-and-white sound slidefilm on this subject for showings to interested groups. Called "Productive Maintenance", the film presents a quick, visual report on the main elements of the program, includes three case histories showing how it is being put to use in industrial plants, and reviews the plan's six major recommendations for good maintenance.

Arrangements for a showing can be made through any of the company's sales offices or service shops.

Meetings and Exhibitions

APRIL

Second Annual Conference on Instrumentation in the Iron and Steel Industry will take place on April 3-4, 1952, at the Roosevelt Hotel, Pittsburgh, Pa. Contact L. Klingenberg, conference chairman, c/o Blaw Knox Chemical Div., 930 Duquesne Way, Pittsburgh, Pa.

American Society of Lubrication Engineers holds its Seventh Annual Meeting and Lubrication Show at the Hotel Statler in Cleveland, Ohio, April 7-9, 1952.

Thirteenth Annual Industrial Electrical Equipment Exposition, sponsored by the Electrical Maintenance Engineers of Milwaukee, will be held April 24-25, 1952, in the Auditorium of the Public Service Bldg., Milwaukee, Wis.

Nipple that failed after one year in main condensate line.
Corrosion of threaded area caused leakage in return line.
these parts were destroyed by RLC
Carbonic acid corrosion eats right through cast iron elbow.
Nipple shows characteristic pitting due to dissolved oxygen.

prevent Return Line Corrosion with Dearborn Formula 700 or 702

These destroyed parts were the victims of *return line corrosion.* If your maintenance costs are high because leaking or clogged return lines require replacement—if rusty condensate is coming back to your boilers—then it will pay you to use Dearborn Formula 700 or 702.

Return line corrosion is caused by oxygen and carbon dioxide. It can be effectively controlled thru the easy, inexpensive application of either the neutralizing amine-type treatment (Formula 700) or Dearborn's new filming-type amine treatment (Formula 702).

Your Dearborn Engineer is prepared to make specific recommendations on the use of Dearborn Formula 700 or 702 in your plant.

DEARBORN CHEMICAL COMPANY
Merchandise Mart Plaza • Chicago 54, Illinois

NOTE: Dearborn holds the basic patent (U.S. Pat. 2400543) for the use of filming amines for treating water.

WRITE FOR THIS BULLETIN

Write for Bulletin 5013 which outlines causes of return line corrosion and describes how it can be controlled by Dearborn Formula 700 or 702.

Dearborn Chemical Company Dept. INP
Merchandise Mart Plaza, Chicago 54, Ill.

( ) Send a copy of Bulletin 5013
( ) Have a Dearborn Engineer call

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Dearborn
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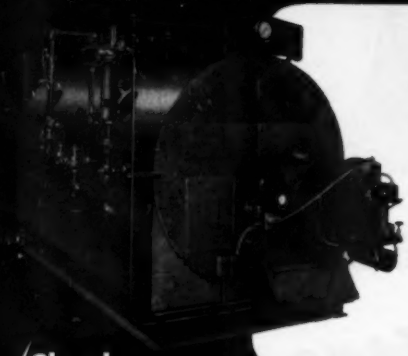
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

SAVE FUEL-SAVE LABOR-

Choose Dutton!

TWO LINES TO SUIT YOUR NEEDS... BOTH FAMOUS FOR EFFICIENCY... LONG LIFE... LOW OPERATING COST



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the compact, automatic "packaged" boiler with exclusive Off-Center Firing

Compare it point-by-point — and you'll see *why* the EconoTHERM's advanced engineering *pays off* in fuel and labor saved! Off-Center Firing results in faster steaming and greater safety with guaranteed 80% efficiency. Completely automatic ... amazingly compact ... 5 or more square feet of heating surface per H.P. Gas or oil fired — to 250 H.P. Write for EconoTHERM Bulletin EC-100B.

Check First with Dutton

OTHER TYPES AND SIZES 5 H.P. AND UP

EconoMIST...

gives you 5-way firing convertibility... plus reliable H. R. T. design

Install it for gas, light oil, heavy oil, stoker, or hand firing — you can later convert the EconoMIST to *any* one of these firing methods. Highly adaptable, it's above all tremendously *dependable*. Of all "packaged" units, EconoMIST sets the standards for operating simplicity and low maintenance costs. Sizes from 15 to 105 H.P. Write for EconoMIST Bulletin EC-100B.

Handy Steam Cost Calculator mailed FREE on request... or ask your Dutton representative. (See Yellow Pages in Phone Book.)

Dutton BOILERS

DIVISION
HAPMAN-DUTTON COMPANY
KALAMAZOO, MICHIGAN • BOILER BUILDERS SINCE 1880

3 special departments featured monthly to give you FREE bulletins, catalogs and product data screened for your personal interest in

ENGINEERED PLANT SERVICES

1. NEW EQUIPMENT

Begins on page 8

Contains highlights of new products by leading manufacturers, briefed and illustrated for your easy reference. Complete data on each of these products are available **free.**

2. NEW BULLETINS

Begins on page 150

Includes descriptions of only those bulletins and catalogs that are really **new** and of **direct value** to you — saves your reading time, yet gives you full service. All bulletins sent to you **free** on request.

3. READERS GUIDE TO ADVERTISED PRODUCTS

Begins on page 133

Designed to catalog advertised products for your convenience in finding the ads which are of special interest to you at this time. Also lists those important bulletins, catalogs and working data offered **free** in the advertisements.

REQUEST CARD FOR LITERATURE OR MORE INFORMATION—April, 1952

To: INDUSTRY AND POWER, St. Joseph, Mich. Please have forwarded to me, at no obligation, the literature I've indicated by the following key numbers:

New Equipment begins Page 8	*New Bulletins begins Page 150*	*Advertised Products begins Page 133*
No's_____	No's_____	No's_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Your Name_____ **Title**_____

Your Company_____

Co. Address (St. & No.)_____

City_____ **State**_____

Inquiries for items listed in this issue not serviced beyond August 1, 1952

FIRST CLASS
PERMIT No. 19
(Sec. 34.9, P.L.&R.)
ST. JOSEPH, MICH.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

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INDUSTRY AND POWER

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ST. JOSEPH, MICH.

3 *special departments featured monthly to give you FREE bulletins, catalogs and product data screened for your personal interest in*

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Your Name _____ **Title** _____

Your Company _____

Co. Address (St. & No.) _____

City _____ **State** _____

Inquiries for items listed in this issue not serviced beyond August 1, 1952

Readers' guide to advertised products

This department is both a product index for advertising and a keyed listing for advertised literature. Refer to advertisement on page indicated and contact advertiser directly—or list paragraph key numbers on reader service card (page 131) to get data you want

AIR & DUST FILTERS & COLLECTORS

Dust Collectors **500**
New Design 3 RAS Catalog No. 601 describes Aerotec Dust Collectors. The Thermix Corp. Adv. page 32.

Dust Collection **501**
Information contained in bulletin "The Collection and Recovery of Industrial Dusts". Buell Engineering Co. Adv. page 151.

ANTI-CORROSIVE & PROTECTIVE COATINGS

Rust Preventive **502**
Adv. page 63 contains coupon for complete information on Rust-Oleum sealing compound. Rust-Oleum Corp.

BOILERS & BOILER ACCESSORIES

Wickes Steam Generators **503**
Descriptive literature available on Wickes steam generators. The Wickes Boiler Co. Adv. page 173.

Mechanical Draft **504**
Latest catalogs on P-D mechanical draft equipment. The Thermix Corp. Adv. page 126.

Boilers **505**
Information on Union "A" Type boilers. Union Iron Works. Adv. page 57.

Steam Generating Units **506**
Bulletin contains information on Vogt two-drum steam generators. Henry Vogt Machine Co. Adv. page 42.

Heavy-Duty Boilers **507**
Complete catalogs and information on Kewanee heavy-duty boilers. Kewanee Boiler Corp. Adv. page 154.

Vertical Unit Boilers **508**
Information on Vertical Unit Boilers. Combustion Engineering-Superheater, Inc. Adv. pages 12, 13.

BUILDING HEATING, VENTILATING, AIR CONDITIONING & REFRIGERATION

Unit Heaters **509**
Complete information on Trane unit heaters and diffusers. The Trane Co. Adv. page 52.

BUILDING MATERIALS & MAINTENANCE

Maintenance Handbook **510**
40-page Handbook on commutator and slip ring maintenance. Ideal Industries, Inc. Adv. page 123.

Industrial Cleaners **511**
Complete details available on G-E heavy-duty cleaning equipment. General Electric Co. Adv. page 159.

Steel Grating **512**
Bulletin 2365 contains information on electroforged steel grating. Blaw-Knox Div., Blaw-Knox Co. Adv. page 156.

Pipe Joint Compound **513**
Free sample of Key-Tite water-proof sealing compound. Key Co. Adv. page 170.

Insulating Roof Tile **514**
Complete details available on Kaylo insulating roof tile. Owens-Illinois Glass Co., Kaylo Div. page 111.

Iron Cement **515**
Free Repair Handbook describes Smooth-On repairs. Smooth-On Mfg. Co. Adv. page 171.

COAL, ASH & BULK HANDLING

Vibrating Screens **516**
Information on Hewitt-Robins vibrating screens. Hewitt-Robins Inc., Robins Conveyors Div. Adv. page 124.

Airslide Conveyor **517**
Information on the F-H airslide conveyer. Fuller Company. Adv. page 141.

Electric Vibrators **518**
Free illustrated folder available on Syntron electric vibrators. Syntron Company. Adv. page 140.

COMPRESSORS

Air Compressors **519**
Full details available on Schramm industrial air compressors. Schramm, Inc. Adv. page 161.

Motor-Driven Compressor **520**
Illustrated catalog available on Clark balanced/opposed, motor-driven air compressor. Clark Bros. Co., Inc. Adv. page 4.

Compressed Air Trap **521**
Technical Bulletin No. 5-CA describes Sarco type FA compressed air trap. Sarco Co., Inc. Adv. page 15.

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PRODUCT INDEX

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Anti-Corrosive & Protective Coatings 133
Boilers & Boiler Accessories 133
Building Heating, Ventilating, Air Conditioning & Refrigeration 133
Building Materials & Maintenance ... 133
Coal, Ash & Bulk Handling 133
Compressors 133
Controls, Regulators & Instruments ... 134
Diesels 134
Electrical Distribution 136
Electrical Heating Units 136
Fans & Blowers 136
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Fuels & Firing Equipment 136
Heat Exchanger Equipment 136
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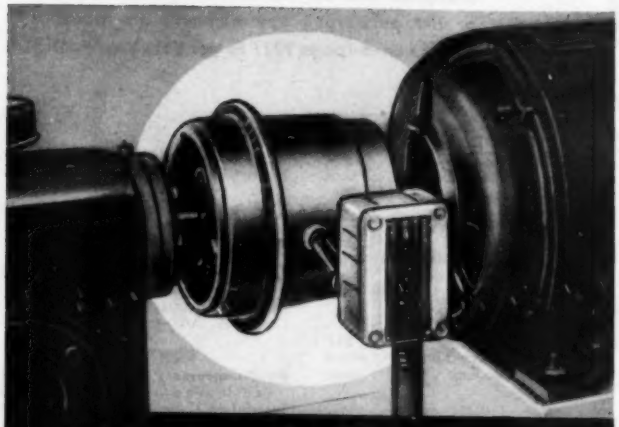
Protect Your Machines Against OVERLOAD and "DOWN TIME"



ANCHOR-WALDRON

Automatic

Overload Cut Out

also available in Pulley Type Unit

With the Anchor-Waldron Cut-Out an automatic device instantly shuts off the motor when an overload occurs; it resets itself automatically. You simply push the starter button—that's all! If the overload has not been removed and the starter button is pushed the cut-out will again block the circuit and again reset itself.

This positive mechanical, electrical and controlled overload cut-out device is adaptable for a wide variation of horsepower. It protects horsepower, eliminates down-time and saves on maintenance work.

Coupling torque range 10 to 2,000 inch-pound.

Pulley type unit torque range 20 to 10,000 inch-pound.

WRITE FOR DESCRIPTIVE CATALOG 51

JOHN WALDRON CORP.

NEW BRUNSWICK NEW JERSEY

Sales Representatives in Principal Cities

Readers' guide to advertised products

(Continued from page 133)

CONTROLS, REGULATORS & INSTRUMENTS

All Metal Thermometers **522**
Catalog T-13 contains complete information on Weston all-metal thermometers. Weston Electrical Instrument Corp. Adv. page 166.

Automatic Controls **523**
Catalog 700 contains complete data on Mercoid automatic controls. The Mercoid Corp. Adv. page 143.

Regulators **524**
Information on Spence pressure and temperature regulators. Spence Engineering Co., Inc. Adv. page 121.

Regulators **525**
Bulletin 316 contains complete data on Powers Accritem regulators and diaphragm valves. The Powers Regulator Co. Adv. page 172.

HOW TO REQUEST FREE LITERATURE

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Regulators **526**
Bulletin 50-1000 contains details on patented Stacon temperature regulators. Farris Stacon Corporation. Adv. page 170.

Testing Instruments **527**
Bulletins available: Pyrometer (GEC836); Wattmeter (GEC-591); Type CF Recorders (GEC-215). General Electric Co. Adv. page 117.

Tank Gauge **528**
Complete details on Liquidometer tank gauge. The Liquidometer Corp. Adv. page 156.

Angle Thermometer **529**
Free Bulletin AA50 describes Weksler adjust-angle industrial thermometers. Weksler Thermometer Corp. Adv. page 139.

Flow Indicators **530**
Details available on the Henszey flow indicator. Henszey Company. Adv. page 160.

DIESELS

Diesels **531**
Information available on Cooper-Bessemer diesel. The Cooper-Bessemer Corp. Adv. page 46.

Dual Fuel Engine **532**
Information available on Worthington dual fuel diesel engines. Worthing-

(Continued on page 136)

WHAT MAKES REPUBLIC'S CHALLENGER TRANSMISSION BELTING MORE EFFECTIVE?

Republic's Challenger Transmission Belting distributes power more efficiently because it's built of pre-stretched, hard-finished rubber-impregnated fabrics with non-slip "frictioneered" surfaces.

Republic's Challenger withstands heaviest shocks and stresses, flexes easily at high speeds over the smallest pulleys.

Free yourself from fastener trouble, belt slippage and premature belt failures. Ask your Republic Distributor how Challenger applies to your job requirements or write direct for full facts.

INDUSTRIAL RUBBER PRODUCTS BY

REPUBLIC RUBBER DIVISION

Lee Rubber & Tire Corporation

YOUNGSTOWN, OHIO

Readers' guide to advertised products

(Continued from page 134)

ton Pump & Machinery Corp., Engine Div. Adv. page 58.

ELECTRICAL DISTRIBUTION

Switchgear 533
Catalog Section 6004 contains complete story on I-T-E low-voltage switchgear. The I-T-E Circuit Breaker Co. Adv. pages 30, 31.

Electrical Conduit 534
Information on Sealtite flexible electrical conduit. The American Brass Co., American Metal Hose Branch. Adv. page 27.

ELECTRICAL HEATING UNITS

Electric Heaters 535
Catalog 50 describes many types of Chromalox Electric Heaters and how to apply them. Edwin L. Wiegand Co. Adv. page 119.

FANS & BLOWERS

Engineered Air Movement 536
Complete information on Hartzell field engineered services. For removal of noxious fumes and gases. Hartzell Propeller Fan Co. Adv. page 2.

Blowers 537
Coupon in adv. page 45 will bring complete information on Coppus blowers and exhausters. Coppus Engineering Corp.

FILTERS, STRAINERS & PURIFIERS

Flo-Klean Strainers 538
Information available on Cuno Flo-Klean Strainers. Cuno Engineering Corp. Adv. page 48.

FUELS & FIRING EQUIPMENT

Spreader Stokers 539
Full information about Perfect Spread Stokers and complete story of Caterpillar installation. American Engineering Co. Adv. pages 106, 107.

RotoGrate Stokers 540
Information on Detroit RotoGrate stokers. Detroit Stoker Co. Adv. pages 22, 23.

Centrafire Stokers 541
Westinghouse Centrafire stokers with Traveling Grate. Westinghouse Electric Corp. Adv. page 65.

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Pulverizer 542
Information on the Riley "50" pulverizer. Riley Stoker Corp. Adv. pages 16, 17.

Coals 543
Full information on bituminous coal. Bituminous Coal Institute. Adv. pages 24, 25.

Coal 544
Adv. page 144 contains information on this product. General Coal Company.

Fuel Oil Units 545
Bulletin OB-37 contains complete details on Enco fuel oil pumping and heating units. The Engineer Company. Adv. page 114.

Underfeed Stokers 546
Information on Canton underfeed stokers in several types and sizes. Canton Stoker Corp. Adv. page 153.

HEAT EXCHANGER EQUIPMENT

Cooling Towers 547
Information on Fluor cooling tower testing facilities. The Fluor Corp. Adv. 61.

Water Heaters 548
P-K Catalog No. 202 describes water heaters. Patterson-Kelley Co., Inc. Adv. page 137.

Instantaneous Water Heaters 549
Engineering details available on Pick instantaneous water heaters. Pick Mfg. Co. Adv. page 143.

LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

Rubilene Oil 550
Information on Sinclair Rubilene oil medium. Sinclair Refining Co. Adv. pages 54, 55.

Stanolith Grease 551
Information on Stanolith grease. Standard Oil Co. (Indiana). Adv. page 47.

Non-Fluid Oil 552
Bulletin 550 and free testing sample of "NR" grade Non-Fluid Oil for all pneumatic tools. New York & New Jersey Lubricant Co. Adv. page 140.

Oil Purifiers 553
Literature describes complete line of Hilco purifiers, filters, reclaimers and conditioners. The Hilliard Corp. Adv. page 157.

Oils and Greases 554
Full information on Sun oils and greases or services of a Sun representative are available. Sun Oil Company. Adv. pages 100, 101.

Colloidal Graphite 555
Bulletin No. 426-10C contains more information on the "Use of Colloidal Graphite for Metalworking Operations." Acheson Colloids Co. Adv. page 115.

MATERIALS OF CONSTRUCTION

Nickel Alloy 556
Bulletin "Inco Standard Alloys for

(Continued on page 138)

what do you want in your valves

AUTOMATIC CONTROL?

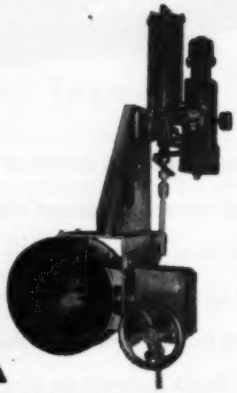
for quick opening and shut-off by motor, air operator, air or hydraulic cylinder or positioning for any desired flow rate? You can get it with Rockwell Butterfly Valves.

RESISTANT CONSTRUCTION?

of cast iron and steel, stainless steel, bronze, Hastelloy, or rubber-lined to withstand chemical or abrasive action? You can have it in Rockwell Butterfly Valves.

DEPENDABLE OPERATION AT ANY TEMPERATURE OR PRESSURE?

of air, gases, liquids and semi-solids at temperatures below freezing or as high as 1600°F, at pressures to 100 p.s.i.g. without clogging or breakdown? You can be sure—if you install Rockwell Butterfly Valves. Pipe sizes—1" to 4" threaded; 4" to 72" flanged or wafer type.



Rubber-lined steel, heavy duty valve for 90 p.s.i. — with air cylinder operator, clutch and auxiliary handwheel control.

Write for Catalog and the monthly "Valve News"

ROCKWELL VALVES

W. S. ROCKWELL CO. • 230 Eliot St., Fairfield, Conn.

SEND FOR THE NEW P-K 40 PAGE WATER HEATER CATALOG

p-k catalog No. 202 provides you with a simple, rapid means of selecting the correct hot water heater for forced circulation.
Capacities from 95 to 101,000 gph.
Steam pressures range from 0 to 100 psig.
Standard "U" Tube Heaters are available in 2- 4- or 6-pass construction.
Water temperatures range from 40° to 100°F. inlet and 80° to 300°F. outlet.

1035

other TAB INDEX FEATURES

- Condensate Cooler tables
- Dishwater Booster Heater tables
- Gravity circulation tables
- Hot Water Service Heater tables
- Pressure drop tables
- Typical piping arrangement

the P-K please send p-k catalog 202

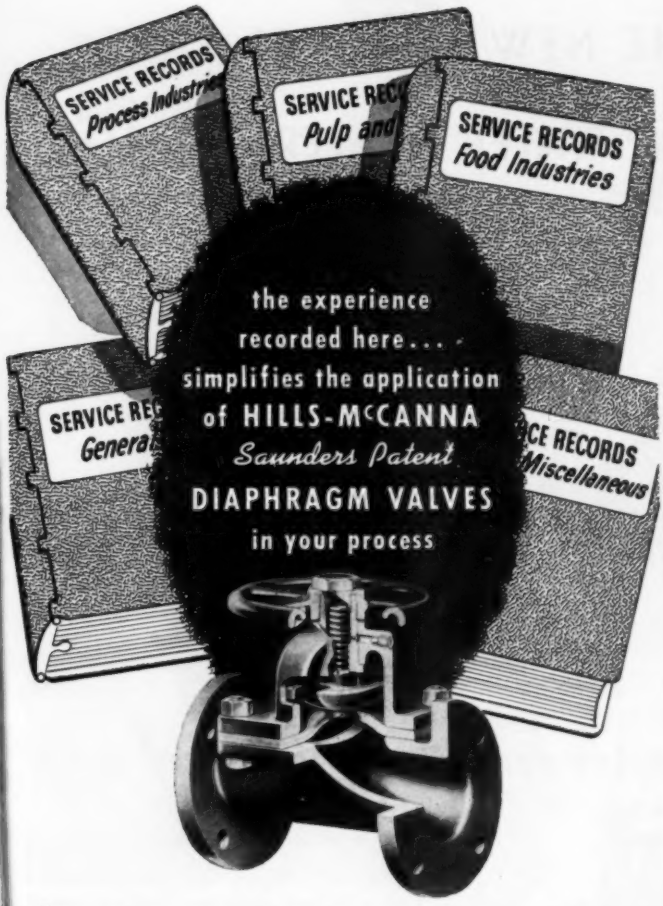
Patterson-Kelley Co., INC.

91 BURSON ST., EAST STROUDSBURG, PENNA.

Name _____ Position _____

Company _____

Street _____ City _____ State _____



If you are conveying corrosive or hard-to-handle fluids, a Saunders Patent Diaphragm Valve may be the answer to your valving problems. If so, the experience recorded in the five volumes illustrated above is your best assurance of getting the *right* valve for your needs. In these records are body and diaphragm material recommendations for handling some 2500 substances, based on Hills-McCanna's nearly 20 years' experience in the manufacture and application of Saunders Patent Valves. If you have a tough valving problem, let this "know-how" work for you.

Hills-McCanna Saunders Patent Diaphragm Valves are made in sizes from ⅜" to 14" for manual, automatic or remote operation with a choice of 13 diaphragm materials and 48 body materials. Write for complete information. HILLS-McCANNA CO., 2355 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA CO.

saunders patent

diaphragm valves

Also manufacturers of — Proportioning Pumps

Force-Feed Lubricators • Magnesium Alloy Castings

Readers' guide to advertised products

(Continued from page 136)

Special Problems" contains data on "S" Monel. The International Nickel Co., Inc. Adv. page 44.

MECHANICAL POWER TRANSMISSION

V-Belts **557**
Information on Dayton Cog-Belts and Thorobred V-Belts. Dayton Rubber Co. Adv. page 102.

V-Belts **558**
Information on Goodyear steel cable V-belts. Goodyear Tire & Rubber Co. Adv. page 3.

V-Belts **559**
Information on Goodrich Grommet belts. The B. F. Goodrich Co., Industrial Products Div. Adv. pages 35, 36, 37, 38.

Roller Bearings **560**
Catalog 547 contains complete data on Hyatt Hy-Load roller bearings. Hyatt Bearings Div., General Motors Corp. Adv. page 145.

Universal Joints **561**
Descriptive literature available on Lovejoy Universal Joints. Lovejoy Flexible Coupling Co. Adv. page 160.

Steel Collars **562**
Descriptive literature on Hallowell solid steel collars. Hallowell Power Transmission Div., Standard Pressed Steel Co. Adv. page 139.

Transmission Belting **563**
Full facts available on Republic's Challenger Transmission Belting. Republic Rubber Div., Lee Rubber & Tire Corp. Adv. page 135.

QD Sheaves **564**
Bulletin V-1400 B7F describes Worthington QD sheaves. Worthington Pump & Machinery Corp., Multi-V-Drive Sales Div. Adv. page 62.

MOTORS AND GENERATORS

Overload Cut Out **565**
Catalog 51 describes Anchor-Waldron automatic overload cut out. John Waldron Corp. Adv. page 134.

PACKAGED STEAM GENERATORS

Superior Steam Generators **566**
Catalog 402 contains complete details on Superior packaged steam generators. Superior Combustion Industries, Inc. Adv. page 113.

(Continued on page 140)

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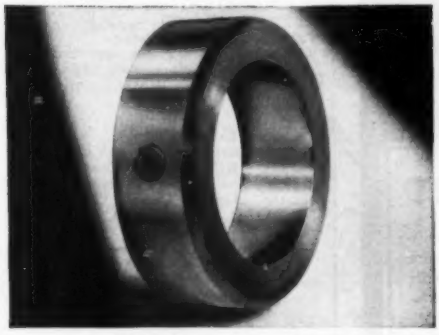
REVOLUTIONARY
ADJUST-ANGLE THERMOMETER
Solves All Equipment Installation Problems
YOUR COSTS ARE LESS . . . Less time on the job for engineers with a WEKSLER ADJUST-ANGLE INDUSTRIAL THERMOMETER because—
NO TIME IS WASTED, Adjusts to ANY angle!
GREATER VISIBILITY . . . Positions to any angle through 180° arc!
REDUCES STOCK REQUIREMENTS . . . Will NOT break under normal shock or vibration!
Today . . . find out how WEKSLER ADJUST-ANGLE THERMOMETER can make things smoother in YOUR plant!
Ask your jobber for IMPORTANT FREE BULLETIN AA80, or write to:
WEKSLER THERMOMETER CORPORATION
52-56 W. Houston St., N. Y. 12, N. Y.
"Industrial America's Right Arm"
WEKSLER NYC

For Industrial Thermometers Send for Catalog 125.
For Glass Engraved on Stem Thermometers and Hydrometers, Send for Catalog 225.
For Dial Indicating and Recording Thermometers, Send for Catalog 325.
For Dial Indicating and Recording Pressure Gauges, Send for Catalog 525.



Standardize on standard
HALLOWELL SOLID STEEL COLLARS

It's fast and easy to buy standardized, precision-made HALLOWELL Solid Steel Collars from your distributor's stocks. Just pick up the telephone and place your order.

42 stock sizes—for shafts from ⅜" to 3" inclusive—are positioned on the shafts by UNBRAKO Self-Locking Set Screws, the screws that won't work loose.

Write for descriptive literature and the name and address of your nearest HALLOWELL Industrial Distributor. STANDARD PRESSED STEEL CO., Jenkintown 39, Pennsylvania.

HALLOWELL
POWER TRANSMISSION DIVISION
SPS
JENKINTOWN PENNSYLVANIA

The modern way to reface handhole seats . . .

ELLIOTT
HANDHOLE SEAT GRINDER

This is one of those accessories that saves its cost many times over in a short period. Corroded or marred handhole seats can be a headache, as after inspections you're never sure the covers are tight until the pressure is on again. And if they are not tight, it takes hours of expert and laborious hand filing to make them so.

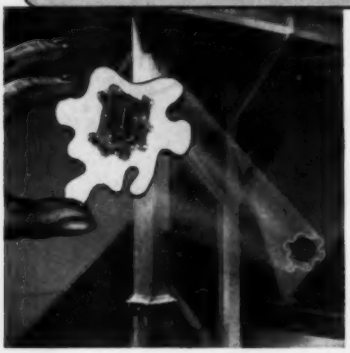
The easy answer is the Elliott Handhole Seat Grinder, which refaces seats on a fixed plane clean and true with positive accuracy, and assures that a boiler put back on the line will stay there, with no need for correcting handhole leaks.

Available with electric motor and pistol grip as shown above, or with air-driven motor. Drives are interchangeable. Full details in Bulletin Y-22, on request.

Y2-7

ELLIOTT Company
LAGONDA DIVISION · SPRINGFIELD, OHIO
Plants at Jeannette, Pa. · Ridgway, Pa. · Ampere, N. J.
Springfield, O. · Newark, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

FIT A SPECIFIC NEED



Assure

free-flowing bins, hoppers and chutes with

SYNTRON

"Pulsating Magnet"

Electric Vibrators

THEY are designed to meet a specific need — to eliminate the arching and plugging of bins, hoppers and chutes. Their 3600 pulsating vibrations per minute keep even the most stubborn materials flowing evenly thru bins, hoppers, chutes and screens — of any size — providing faster processing of materials without the hammering and rodding that wastes manpower and damages equipment.

Write Today For FREE Illustrated Folder

SYNTRON COMPANY

425 Lexington Avenue Homer City, Penna.

NON-FLUID OIL

TRADE MARK REGISTERED

THE "LIVELY" LUBRICANT

Tests prove that NON-FLUID OIL stays "alive" longer than lubricating greases when used on ball bearings—providing constant, dependable lubrication.

This is due to the unique process by which NON-FLUID OIL is made, and through which it acquires greater stability and higher protective properties than can possibly be afforded by grease lubrication. Greases dry out or harden after a period of time, so actually become "dead" and have little lubricating qualities.

We invite you to send for testing samples which will prove our claim that NON-FLUID OIL stays "alive" l-o-n-g-e-r, outlasting ordinary lubricants 3 to 5 times.

NEW YORK & NEW JERSEY LUBRICANT COMPANY

292 Madison Avenue, New York 17, N. Y.

Works: Newark, N. J.

WAREHOUSES: Atlanta, Ga. - Birmingham, Ala. - Charlotte, N. C. - Columbus, Ga. Greensboro, N. C. - Greenville, S. C. - Chicago, Ill. - Detroit, Mich. - Providence, R. I. St. Louis, Mo.

NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

Readers' guide to advertised products

(Continued from page 138)

Packaged Steam Boilers **567**
Fully illustrated and descriptive Cleaver-Brooks steam boiler catalog. Cleaver-Brooks Co. Adv. page 105.

Clayton Steam Generators **568**
Catalog contains information on Clayton Forced Recirculation Steam Generators. Clayton Mfg. Co. Adv. page 34.

Preferred Steam Generators **569**
Bulletin 1000 contains data on Preferred unit steam generators. Preferred Utilities Mfg. Corp. Adv. page 118.

Packaged Automatic Boiler **570**
Literature describes Continental Packaged Steam Generators. Boiler Engineering & Supply Co. Adv. page 127.

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Package Steam Generator **571**
Catalog PG-51-2 contains information on Foster Wheeler package steam generators. Foster Wheeler Corp. Adv. pages 28, 29.

Packaged Boilers **572**
Econotherm Bulletin and Economist Bulletin EC-100B describe Dutton packaged boilers. Free steam cost calculator. Hapman-Dutton Co., Dutton Boiler Div. Adv. page 130.

Self-Contained Generators **573**
Manual 101-A, Steam-Pak's 208-page Architects' Manual contains complete reference on steam generators. York-Shipley, Inc. Adv. page 167.

PACKING AND GASKETS

Mechanical Seal **574**
Bulletin "Dura Seal" contains data on mechanical sealing. Durametallic Corp. Adv. page 146.

PIPE AND FITTINGS

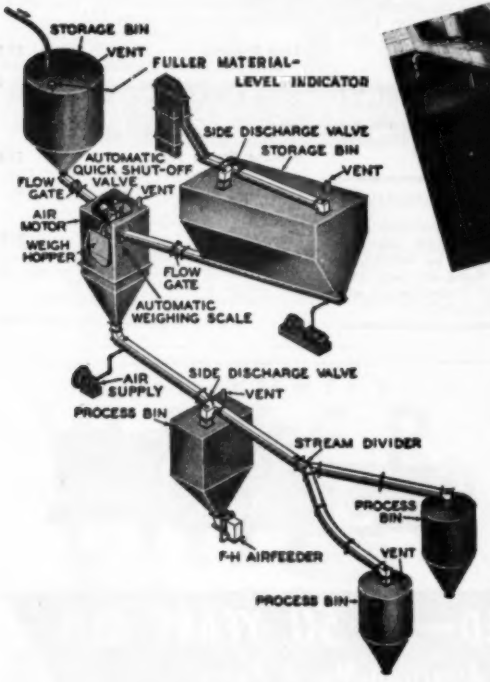
Flexible Metal Hose **575**
Literature available on the CMH line of flexible metal hose. Chicago Metal Hose Div., Flexonics Corp. Adv. page 155.

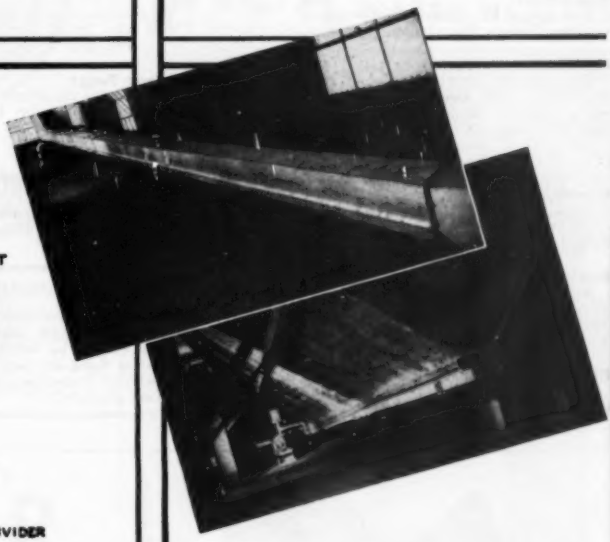
Pipe Fabrication **576**
Pipe fabrication for oil, chemical, concrete, asphalt and other industrial requirements to specifications. Albert Pipe Supply Co. Adv. page 128.

(Continued on page 142)

only the material moves

in the F-H Airslide®





It's simple—it's sure—it's sanitary—it's safe, (no hazardous moving parts)—it saves—this improved method of *flowing* fine, dry materials. The F-H Airslide Conveyor is being more and more widely considered, and used, in various industries. It eliminates dust nuisances, saves man-hours, keeps production flowing smoothly at minimum operating cost.

The F-H Airslide consumes little power—only that required for a small volume of air at low pressure. Valuable floor space is saved, and the system can be installed with a flexibility impossible to obtain with a conventional conveyor.

Chemical processing plants of every size and type will find the Airslide Conveyor the solution to the problem of transporting fine, dry materials, with maximum efficiency and economy.

A Fuller engineer can show you how the system can be put to work for you—how you can increase efficiency while you reduce operating costs. Why not contact us today?

Fuller

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS—COMPRESSORS AND VACUUM PUMPS—FEEDERS, AND ASSOCIATED EQUIPMENT

FULLER COMPANY, Catasauqua, Pa.
120 So. LaSalle St., Chicago 3
420 Chancery Bldg., San Francisco 4

FH-30

Readers' guide to advertised products

(Continued from page 140)

Expansion Joints 577
Yarway Bulletin EJ-1912 contains full data on gun-pakt expansion joints. Yarnall-Waring Co. Adv. pages 50,51.

Pipe Unions 578
Adv. page 163 contains information on Dart Unions. Dart Union Company.

Flexible Metallic Tubing 579
Illustrated folder "Flexineering" contains data on Penflex tubing. Pennsylvania Flexible Metallic Tubing Co., Inc. Adv. page 40.

PUMPS

Centrifugal Pumps 580
General service Unipump for handling liquids. The Weinman Pump Mfg. Co. Adv. page 112.

Vertical Turbine Pumps 581
Adv. page 60 gives information on Worthington vertical turbine pumps. Worthington Pump & Machy. Corp., Vertical Turbine Pump Div.

Chemical Proportioning Pump 582
Literature and prices available on all-purpose chemical proportioning pump. % Proportioneers, Inc. % Adv. page 116.

Centrifugal Pumps 583
Condensed Catalog "M" contains information on Aurora pumps. Aurora Pump Co. Adv. page 156.

Condensation Pumps 584
Information on close-coupled condensation pumps in single and duplex units. Hoffman Specialty Co. Adv. page 125.

General Purpose Pumps 585
Bulletin No. B-1350 describes Peerless Type AS general purpose pumps. Peerless Pump Div., Food Machy. & Chemical Corp. Adv. page 39.

Controlled Volume Pumps 586
Information available on Milton Roy controlled volume pumps for boiler water treatment. Milton Roy Co. Adv. page 19.

Pumps 587
Specific data available on centrifugal, turbine, steam and power pumps. American-Marsh Pumps. Adv. page 142.

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REFRACTORY CONCRETES

Refractory Cement 588
Bulletin R-52 contains information on R&L Moldit refractory cements. Refractory & Insulation Corp. Adv. page 164.

SOOT BLOWERS & TUBE CLEANERS

Tube Cleaners & Expanders 589
Full details on Airetool tube cleaners and expanders. Airetool Mfg. Co. Adv. page 162.

Tube Expanders 590
Information on Series 1500 tube expanders. The Gustav Wiedeke Co. Adv. page 146.

Tube Expanders 591
Bulletin 380 contains complete data on Wilson tube expanders. Thomas C. Wilson, Inc. Adv. page 172.

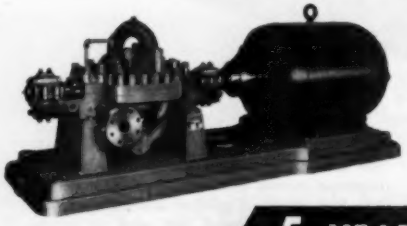
Soot Blowers 592
Information on Diamond Model 1K long retracting soot blower. Diamond Power Specialty Corp. Adv. page 122.

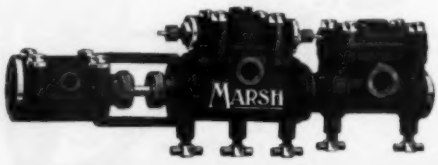
STEAM SPECIALTIES

Impulse Steam Traps 593
Yarway Impulse Steam Traps (free copy of 16-page Selector). Yarnall-Waring Co. Adv. page 66.

Traps 594
Catalog 68-J describes complete line of Strong traps. Strong, Carlisle & Hammond Co. Adv. page 159.

(Continued on page 144)





"Pumps and Pumps Only Since 1873"

5 YEARS OLD—OR 50 YEARS OLD
—if it's an American-Marsh Pump
YOU KNOW YOU CAN GET REPLACEMENT PARTS!

Ever order replacement parts for your equipment—and learn that you have an "orphan model"? A reply beginning, "Sorry, the parts you ordered are no longer obtainable" can cause you real headaches.

If it's an American-Marsh Pump, this won't happen to you! Whether your pump is five years old—or fifty—we're ready to help you keep it working for years to come. And that's but part of the story. For although Service is unusually good at A-M, you're likely to need *very little of it* when you buy American-Marsh Pumps. Since 1873, they've been earning high praise for endurance, efficiency and dependability.

Any way you look at it, they're built to *solve* pumping problems—and *keep* them solved! Why not investigate further?

Write us your requirements—we'll forward specific data.

CENTRIFUGAL, TURBINE, STEAM AND POWER PUMPS FOR TESTING, PROCESSING, BOILER FEED, ETC.

AMERICAN-MARSH PUMPS
BATTLE CREEK MICHIGAN
U.S.A.

In Canada: American-Marsh Pumps (Canada), Ltd., Stratford, Ont.

CONTROLS PERFORM IMPORTANT RESPONSIBILITIES, AND SHOULD BE SELECTED WITH DISCRIMINATION

FOR INDUSTRIAL APPLICATIONS REQUIRING POSITIVE CONTROL OF PRESSURE, TEMPERATURE, LIQUID LEVEL ETC.

MERCOID

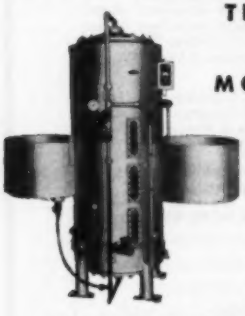
Is your guarantee of Complete Satisfaction

WRITE FOR CATALOG 700 -- PLEASE MENTION THIS PUBLICATION

THE MERCOID CORPORATION • 4201 BELMONT AVENUE • CHICAGO, ILLINOIS

HIGH PURITY
WATER
For Boiler Feed, Process & Other Needs

THE LOW COST*
Penfield
MONO-BED WAY



Operating on the most efficient deionizing technique known (intimately mixed cation and anion resins in a single unit tank), the raw water passes through a Penfield Mono-Bed Demineralizer only once — *yet comes out with a mineral content of virtually zero.* No heat or steam power is ever required, and regeneration of the resins is accomplished by simple gravity and displacement methods.

***COSTS LESS TO PURCHASE, OPERATES FOR LESS THAN 15¢ PER 1000 GALS.**

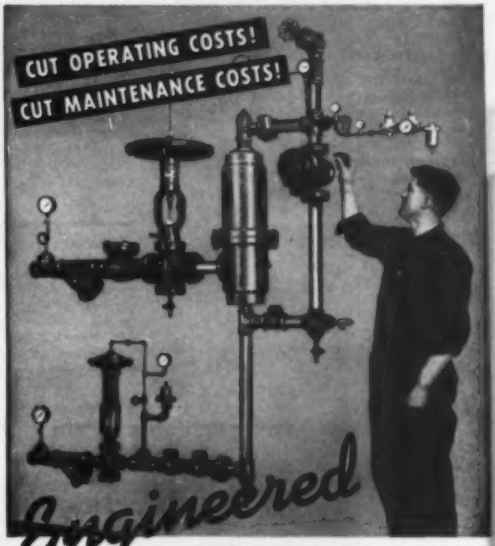
Whether your requirements for dependable, high-purity water are 10 g. p. h. or 10,000 g. p. h., there is a Penfield "Planned Purity" System waiting to make important savings for you in both original equipment and operating costs. Write today for new catalog showing all Penfield water-treating equipment.

PENFIELD MANUFACTURING CO., INC.
19 High School Ave., Meriden, Conn.
FILTERS · SOFTENERS · DEGASIFIERS · DEMINERALIZERS

Penfield "Planned Purity" PAYS!

THE SURE WAY TO
CUT HOT WATER
Costs!

Pick INSTANTANEOUS WATER HEATERS



TO PROVIDE
ANY VOLUME OF WATER
AT THE TEMPERATURE REQUIRED!

Here's the money-saving answer to hot water required for industrial needs. PICK Heaters provide hot water *instantly* — by steam injection. They're entirely automatic to provide and accurately maintain temperatures up to 180° F. The exclusive Pressurizer Piston stabilizes injection pressure — eliminates pipe hammering and shaking. Available in seven sizes with rated capacities of 10 to 200 gallons per minute. Greater volumes can be obtained by multiple installations. Installation is simple, requiring only ordinary pipe connections.

NO STORAGE TANKS NEEDED
Compact design permits installation in corners, on walls or overhead.

EASILY CLEANED
No coils. Can be cleaned in a matter of minutes — without dismantling.

Proved
BY PERFORMANCE IN
FACTORIES • HOSPITALS
LAUNDRIES • BREWERIES
DAIRIES • TANNERIES
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For Engineering Details and Specifications, Write Dept. IP2

MANUFACTURED BY
PICK MANUFACTURING CO.
WEST BEND, WISCONSIN, U.S.A.

Readers' guide to advertised products

(Continued from page 142)

Steam Traps 595
Book "Solving Steam Trap Problems" contains details. The V. D. Anderson Co. Adv. page 174.

Supply Valves & Traps 596
Thermo traps and supply valves described in bulletins. Illinois Engineering Co. Adv. page 152.

THERMAL INSULATION

Pipe Insulation 597
Information on Fiberglas PF pipe insulation. Owens-Corning Fiberglas Corp. Adv. page 21.

Rockwool Insulation 598
Complete information available on all purpose Black Rockwool Insulation. Baldwin-Hill Co. Adv. page 109.

TOOLS

Handhole Seat Grinder 599
Bulletin Y-22 contains full details on Elliott handhole seat grinder. Elliott Co., Lagonda Div. Adv. page 139.

Masonry & Concrete Saws 600
Complete details on masonry and concrete saws. Clipper Mfg. Co. Adv. page 49.

Valve and Bib Reseater 601
See advertisement page 148 for data on Skinner valve and bibb reseater. M. B. Skinner Co.

Blower Suction Cleaner 602
Clements-Cadillac blower-suction cleaner. 5 models with attachments. Clements Mfg. Co. Adv. page 156.

Snap-On Tools 603
Industrial Catalog and 104-page general catalog describe Snap-on tools. Snap-On Tools Corp. Adv. page 158.

TURBINES

Gearturbines 604
Booklet B-4346 contains complete data on Westinghouse Gearturbines. Westinghouse Electric Corp. Adv. page 41.

Steam Turbines 605
Information on Terry steam turbines. The Terry Steam Turbine Co. Adv. page 110.

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VALVES

Cast Steel Valves 606
Bulletin No. 5003 describes Darling cast steel valves. Darling Valve & Mfg. Co. Adv. page 149.

Diaphragm Valves 607
Complete information available on Hills-McCanna Saunders patent diaphragm valves. Hills-McCanna Co. Adv. page 138.

Pump Valves 608
Catalog contains information on Sims pump valves. Sims Pump Valve Co., Inc. Adv. page 152.

Butterfly Valves 609
Catalog and "The Valve News" describe Rockwell valves. W. S. Rockwell Co. Adv. page 136.

Small Steel Valves 610
8-page booklet gives complete information on Lip-Seal Valves. Crane Co. Adv. page 7.

Check Valves 611
Catalog No. 30 contains complete information on Chapman Tilting Disc check valves. Chapman Valve Mfg. Co. Adv. page 56.

Corrosion-Resistant Valves 612
Information on Aloyco corrosion-resistant valves. Alloy Steel Products Co., Inc. Adv. page 33.

(Continued on page 148)

GENERAL
REG. U.S. PAT. OFF.

RODA — High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

HENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

GLENBROOK — The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE — Roda and Stonega from Wise County, Va.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL — High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER — Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO — High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

ANTHRACITE
Hazel Brook—*Premium Lehigh*
Raven Run—*Premium Mahanoy*
Cross Creek—*First Grade Lehigh*

Our engineering service, available upon application, and long and varied experience is your assurance of the Right Coal — Properly Applied.

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CABLE ADDRESS, GENCO
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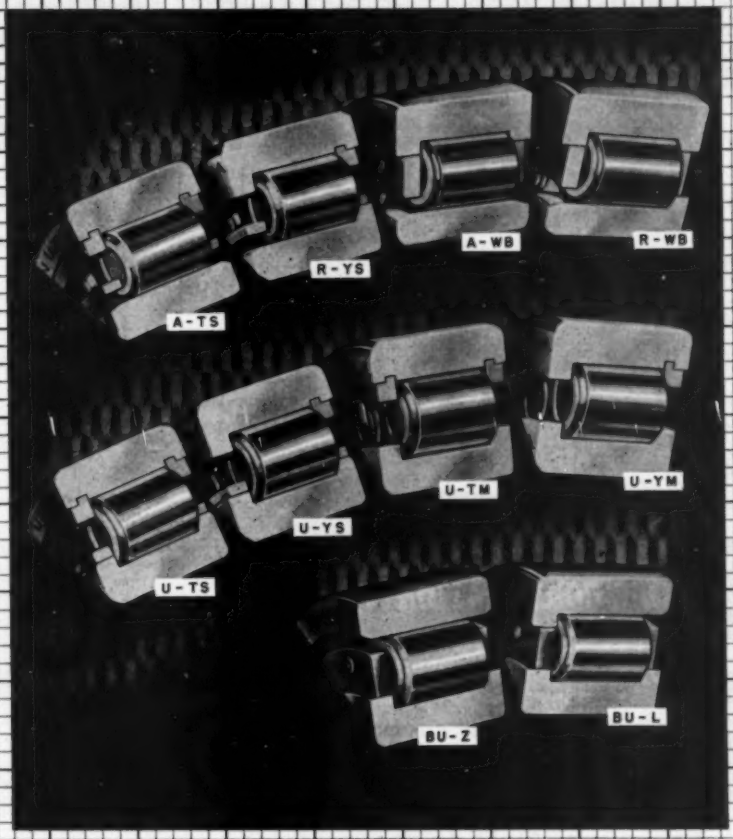

HYATT HY-LOADS

The complete line of Radial Bearings

In the selection of bearings for any application, assembly methods, speed, load, life, shaft location, lubrication, and available space must all be carefully considered.

Accordingly, Hyatt Hy-Load Roller Bearings are made available in ten major types and a full range of sizes because no single bearing type nor small number of types can meet all of the wide variety of design requirements or combination of operating conditions.

* * *

Hyatt Catalog 547, containing all the needed design data, places a wealth of bearing information at your fingertips. If you do not have a copy let us send one to you. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

DURA SEAL means mechanical sealing at its best!

The ultimate sealing device for petroleum processing equipment

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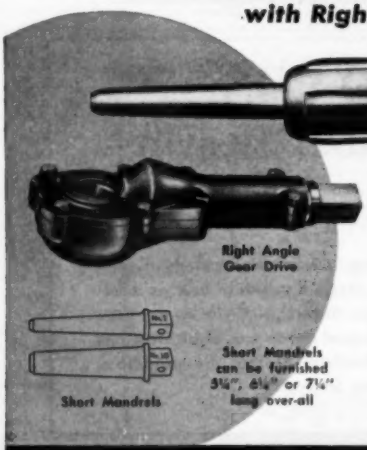
DURAMETALLIC CORPORATION
KALAMAZOO, MICHIGAN

IDEAL

for more Speed and greater Efficiency

Series 1500 Tube Expanders

with Right Angle Gear Drive



For installation and maintenance of tubes in drums, headers and similar water tube boiler units. Made in sizes for tubes up to 4½" O.D. Ideal Tube Expanders with different length rolls can be furnished to suit various thicknesses of drums or headers.

See Your Dealer or Write Us Today!

THE GUSTAV WIEDEKE COMPANY
DAYTON 1, OHIO

Readers' guide to advertised products

(Continued from page 144)

Everlasting Valves **613**
Bulletin describes Everlasting valves in detail. Everlasting Valve Co. Adv. page 168.

WATER TREATMENT

Ion Exchangers **614**
Bulletin 28X7808 describes alkalinity reduction by ion exchange. Allis-Chalmers Mfg. Co. Adv. page 53.

Water Conditioning **615**
Information on Elgin water conditioning systems for every need. Elgin Softener Corporation. Adv. page 147.

Water Treatment **616**
Further details available on Nalco water treatment security. National Aluminate Corp. Adv. page 9.

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Return Line Corrosion **617**
Bulletin 5013 outlines causes of return line corrosion and describes its control. Dearborn Chemical Co. Adv. page 129.

Water Conditioning **618**
Advertisement page 59 contains information on Worthington water softening systems. Worthington Pump & Machy. Corp., Water Treating Section.

Water Treatment **619**
New catalog shows all Penfield water-treating equipment. Penfield Manufacturing Co., Inc. Adv. page 143.

Boiler Water Comparator **620**
Free data book "Modern pH and Chlorine Control" contains data on Taylor boiler water comparators. W. A. Taylor and Co. Adv. page 6.

Boiler Scale Removal **621**
Recommendations for corrective or preventive boiler scale treatment. Power Chemicals Div., E. F. Drew & Co., Inc. Adv. page 43.

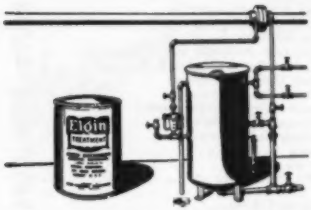
Water Conditioning Service **622**
Free Technical Paper No. 98 "Boiler Scale—Its Formation and Prevention". W. H. & L. D. Betz. Adv. page 11.

Softener System **623**
Recommendations available on hot process softener systems for water treatment. Graver Water Conditioning Co. Adv. page 64.

Water Treatment **624**
Details available on demineralizing plant for deionized water. Hungerford & Terry, Inc. Adv. page 171.

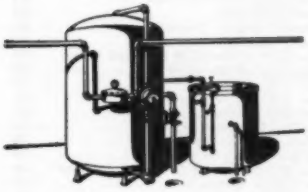
—End

Which of these methods will best fit your water conditioning needs?



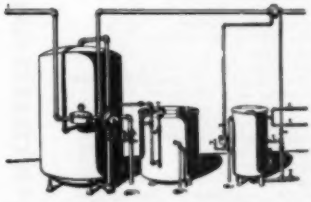
1 CHEMICAL FEED

In many cases, individually prepared Elgin Chemical Treatment alone will effectively prevent scale formation and corrosion.



2 ZEOLITE SOFTENING

A zeolite water softener will efficiently eliminate hardness, scale, and lime deposits.



3 ZEOLITE — POST TREATMENT

A zeolite softener, supplemented by chemical treatment will not only eliminate hardness, but will also prevent corrosion.

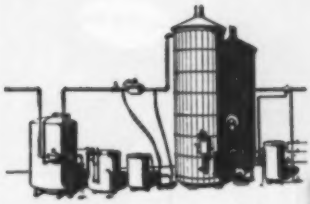
FOR AN UNBIASED ANSWER . . . CALL YOUR ELGIN MAN

Chances are that one of these basic Elgin systems will fit your water conditioning needs. If not, there is no limit to the number of systems we can "tailor" to your exact requirements and budget.

Whether a simple chemical feed system, a zeolite water softener, one of the many ion-exchange combinations, silica and CO_2 removal, or deionization for the highest quality water known today — you may be sure Elgin can provide the type of system required to produce water of the exact characteristics you require.

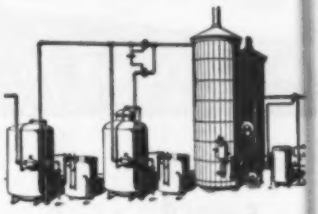
Nearly a half century of water conditioning experience is yours for the asking

Most important is the fact that Elgin's skill and experience, gained through nearly a half century devoted exclusively to the field of water conditioning, is yours for the asking — through our district engineer in your vicinity. Write, wire or phone, and we will put him in touch with you.



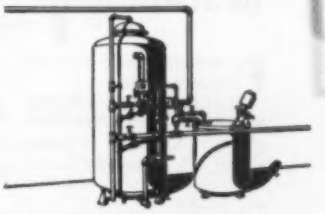
4 ZEOLITE — ALKALINITY NEUTRALIZATION

Water of low-controlled alkalinity, with CO_2 removed, can be produced by acid feed and degasification following zeolite softening.



5 SODIUM — HYDROGEN SOFTENING AND DEGASIFICATION

Blended effluents from a sodium zeolite softener and a hydrogen zeolite softener, followed by degasification, give water in which total solids and alkalinity is reduced and CO_2 is removed.



6 DEIONIZATION INCLUDING SILICA AND CO_2 REMOVAL

Single-tank Ultra-Deionizer produces the equivalent of distilled water, free from silica and CO_2, at amazingly low cost.

ELGIN
SINCE 1908
WATER CONDITIONING FOR EVERY NEED

ELGIN SOFTENER CORPORATION
138 North Grove Avenue, Elgin, Illinois
REPRESENTATIVES IN PRINCIPAL CITIES

RESEAT VALVES
AND BIBBS
IN PLACE
QUICKLY
ACCURATELY
RESEATING A BIBB
RESEATING A VALVE
PAYS FOR ITSELF ON FIRST 2 OR 3 JOBS!
Don't junk expensive globe or angle valves, bibbs, fixtures - reseat them! Order Skinner Valve and Bibb Reseater. Easy to use. Guaranteed cutters leave seat glass-smooth, level, tight.
1/4" to 2" $32.75
1/4" to 3" $40.50
M. B. SKINNER CO.
SOUTH BEND 21, INDIANA, U.S.A.

this sword means Cancer RESEARCH

For millions cancer research is a race for life.

The American Cancer Society supports research in 100 institutions in 35 states . . . grants aid to 900 investigators . . . trains as fellows 78 young men and women.

However, some vital research has been retarded because of lack of funds . . . twice as many dollars could be used in 1952 under the sign of the cancer sword. Cancer Strikes One in Five. Your Dollars Strike Back.

Mail Your Gift to "Cancer" Care of Your Local Postoffice

AMERICAN CANCER SOCIETY

QUICK REFERENCE TO BULLETINS AND CATALOGS OFFERED BY ADVERTISERS IN THIS ISSUE

List "Key Numbers" for literature desired on the postal card on page 131

Page No.	Advertiser	Catalog	Key No.
115	Acheson Colloids Company	Colloidal Graphite for Metalworking	585
32	Aerotec Corp., The	Dust Collectors	500
163	Airetool Mfg. Co.	Tube Cleaners and Expanders	589
53	Allis-Chalmers Mfg. Co.	Ion Exchangers	614
106	American Engineering Co.	Perfect Spread Stokers	539
142	American Marsh Pumps	Pumps	587
174	Anderson Co., The V. D.	Steam Traps	595
156	Aurora Pump Co.	Centrifugal Pumps	583
109	Baldwin-Hill Co.	Black Rockwool Insulation	598
11	Betz, W. H. & L. D.	"Boiler Scale Formation & Prevention"	622
156	Blaw-Knox Div. of Blaw-Knox Co.	Steel Grating	512
127	Boiler Engineering & Supply Co.	Continental Packaged Steam Generators	570
151	Buell Engineering Company	Industrial Dust Collection & Recovery	501
56	Chapman Valve Mfg. Co., The	Tilting Disc Check Valves	611
4	Clark Bros. Co., Inc.	Motor-Driven Compressors	520
34	Clayton Mfg. Co.	Forced Recirculation Generators	568
105	Cleaver-Brooks Co.	Packaged Steam Boilers	567
49	Clipper Mfg. Co.	Masonry and Concrete Saws	600
48	Cooper-Bessemer Corp.	Diesels	531
45	Coppus Engineering Corp.	Blowers	537
7	Crane Co.	Small Steel Valves	610
48	Cuno Engineering Corp.	Flo-Klean Strainers	538
149	Darling Valve & Mfg. Co.	Cast Steel Valves	606
129	Dearborn Chemical Co.	Return Line Corrosion	617
43	Drew & Co., Inc., E. F.	Boiler Scale Removal	621
146	Durametallic Corp.	Mechanical Seals	574
139	Elliott Co., Lagonda Div.	Handhole Seat Grinder	599
114	Engineer Co., The	Fuel Oil Units	545
168	Everlasting Valve Co.	Valves	613
170	Farris Stacon Corp.	Regulators	526
155	Flexonics Corp., Chicago Metal Hose Div.	Flexible Metal Hose	575
28	Foster Wheeler Corp.	Packaged Steam Generators	571
117	General Electric Co.	Testing Instruments	527
159	General Electric Co.	Industrial Vacuum Cleaners	511
145	General Motors Corp., Hyatt Bearings Div.	Hy-Load Roller Bearings	560
130	Hapman-Dutton Co., Dutton Boiler Div.	Econotherm & Economist Packaged Boilers	572
2	Hartzell Propeller Fan Co.	Engineered Air Movement	536
160	Hennsey Company	Flow Indicators	530
157	Hilliard Corp., The	Lube and Fuel Oil Purifications	553
138	Hills-McCanna Co.	Diaphragm Valves	607
171	Hungerford & Terry, Inc.	Un-A-Bed Demineralizing Plant	624
123	Ideal Industries, Inc.	Maintenance Handbook	510
152	Illinois Engineering Co.	Supply Valves & Traps	596
44	International Nickel Co., Inc.	"Inco Standard Alloys for Special Problems"	556
30	I-T-E Circuit Breaker Co.	Low Voltage Switchgear	533
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170	Key Company	Pipe Joint Compound	513
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160	Lovejoy Flexible Coupling Co.	Universal Joints	561
143	Mercoid Corporation	Automatic Controls	523
19	Milton Roy Co.	Controlled Volume Pumps	586
140	New York & New Jersey Lubricant Co	Non-Fluid Oil	552
111	Owens-Illinois Glass Co., Kaylo Div.	Insulating Roof Tile	514
157	Patterson-Kelley Co., Inc.	Water Heaters	548
39	Peerless Pump Division	General Purpose Pumps	585
143	Penfield Manufacturing Co., Inc.	Water Treating Equipment	619
40	Penna. Flexible Metallic Tubing Co.	"Flexineering"	579
145	Pick Mfg. Co.	Instantaneous Water Heaters	549
172	Powers Regulator Co.	Accritem Regulators & Diaphragm Valves	575
126	Prat-Daniel Corp.	Mechanical Draft Equipment	504
118	Preferred Utilities Mfg. Corp.	Unit Steam Generators	569
116	% Proportioneers, Inc. %	Chemical Proportioning Pump	582
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113	Superior Combustion Industries, Inc.	Packaged Steam Generators	566
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58	Engine Division	Dual Fuel Engine	532
50	Yarnall-Waring Co.	Expansion Joints	577
66	Yarnall-Waring Co.	Impulse Steam Traps	593
167	York-Shipley, Inc.	Architects Manual on Steam Generators	573

WHY seat misalignment doesn't cause this Darling Valve to leak!

NO gate valve body ever made is entirely immune to distortion caused by line stresses and temperature changes. Yet even slight distortion can throw the seats out of alignment—probably the most common cause of leaky valves and costly replacement.

That's one reason why Darling gate valves, with their unique wedging principle combined with fully revolving double discs and parallel seats, have the jump on other valves. They easily, *automatically* adjust for valve body distortion, cinching tight, leak-proof closure without destructive strong-arm tactics. Most important, you avoid costly down-time and repeated maintenance headaches.

But that's not all! Actually, this Darling principle offers several other equally important time-and-money-saving advantages. In plant after plant they add up to trouble-free performance and longer service life with a very minimum of attention.

GET ALL THE FACTS

Send for descriptive cast steel valve Bulletin No. 5003.

DARLING VALVE & MANUFACTURING CO.

Williamsport 9, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

NOTE: *Darling gate valves are made in a wide range of sizes, types and constructions, including solid and slotted taper-seat wedge types, for all kinds of normal and corrosive services in pressures up to 1500 pounds.*

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

New bulletins and catalogs

Literature on engineering products and developments

Each new bulletin item has a key number for your convenience in asking for a free, personal copy. Insert key numbers on return post card found on page 131

AIR & DUST FILTERS & COLLECTORS

Cloth Type Collector **200**

Use of cloth-type dust collectors in the ceramics industry is discussed in 4-page folder 252-A. Photos and brief case histories of actual installations are presented. Advantages are listed and a cutaway view shows operating principles. The synthetic cloths used will withstand high temperatures. American Wheelabrator & Equipment Corp.

Cloth Type Collector **201**

If you are concerned with dust collection, 4-page folder 101 should be of interest. Cloth screen collectors, featuring continuous automatic cleaning by reverse air flow, are illustrated. Mechanical shaking is eliminated and uniform suction is said to result. Advantages and how they operate are fully discussed. The W. W. Sly Manufacturing Co.

ANTI-CORROSIVE & PROTECTIVE COATINGS

Protective Coatings **202**

If the floors, walls, ceilings or structural steel of your plant are subject to chemical corrosion, you may find data sheet 501 useful. Resistance of manufacturer's line of protective coatings to practically all commonly used corrosive chemicals is listed in chart form. Coatings are also used for equipment such as tanks, pipes, ducts and machinery. Prufcoat Laboratories, Inc.

Plastic Paint **203**

Characteristics, applications, and methods of use for a corrosion resistant protective plastic paint are described in 8-page bulletin 201. Protecting against chemical attack, abrasive action, salt water corrosion and other similar conditions, it can be used on metals, concrete, brick, stone, plaster and asbestos board. The Corrosite Corp.

Rust Preventatives **205**

Coatings which may be applied over rusted surfaces without removing all the rust are featured in 16-page catalog 251. Contents page lists characteristics and recommended uses for long and short oil type coatings, machinery finishes, heat and chemical resistant coatings, sealers, thinners, and floor finishes. Color chips are used to show exact colors. In addition to information and data on each type of coating, instructions for application, resistant qualities, drying times, thinners and special applications are also included. Rust-Oleum Corp.

BUILDING HEATING, VENTILATING & AIR CONDITIONING & REFRIGERATION

Smoke Detector **206**

Principles of operation and construction features of a smoke detector for air conditioning systems are described in data sheet AC-2. Presence of smoke in the air ducts causes instrument to automatically shut off circulation. Mounting details are shown by a drawing. Ess Instrument Co.

Cooling Coils **207**

Booklet DS-365, 72 pages, may make a valuable addition to your engineering data files. Extended surface cooling coils for use with direct expansion refrigerants or chilled water for air conditioning and process applications are fully described and illustrated. More than 50 pages are devoted to engineering data presented in the form of selection instructions, specifications, tables, charts and diagrams for selection of the proper design for any air conditioning, industrial or process application. The Trane Co.

Water Blenders **208**

Cold and hot water are automatically blended to any desired temperature by a water blender described and illustrated in 4-page folder 800-A. How they work, specifications and prices are included. Engineering data is presented in graph form, and piping diagrams illustrate applications. Sarco Co., Inc.

BUILDING MATERIALS & MAINTENANCE

Iron Cements **209**

Many helpful suggestions for making simple reliable repairs on equipment and piping with iron cement are presented in 40-page pocket-size pamphlet. Iron cements for many uses are described. Patching cement, aluminum and bronze cement, concrete paint, gaskets and clamps are also presented. Also included is a folder describing advantages and how to apply concrete paint No. 15, for interior or exterior use. Smooth-On Mfg. Co.

COMPRESSORS

Portable Air Compressors **210**

Design features and specifications for portable air compressors are presented in illustrated 16-page catalog 5101. Units are available in sizes from 20 to 600 cu ft with gasoline or diesel engine drives. Two wheel, four wheel and skid mountings are shown. Illustrated quick reference chart gives recommended applications and complete specifications for each model size. Schramm Inc.

Air Line Filters **211**

"Dry-Clean Compressed Air," 4-page folder PJL 0549, describes the advantages of filters for compressed air lines. Several models and actual installations are illustrated. Recommended uses are listed and complete specifications are given. The Cuno Engineering Corp.

CONTROLS, REGULATORS & INSTRUMENTS

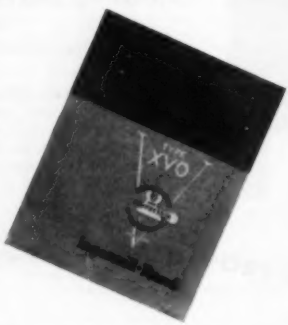
Blending System **212**

Construction, operation, advantages, specifications and applications of a system for accurately blending two or more liquids in increments as low as 1/20 per cent are discussed in a 12-page

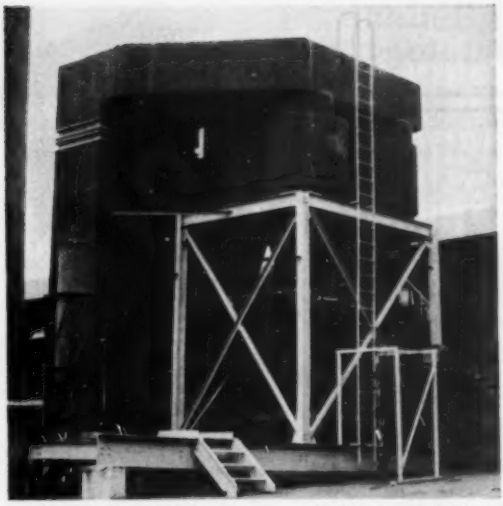
(Continued on page 152)

Air Compressors **204**

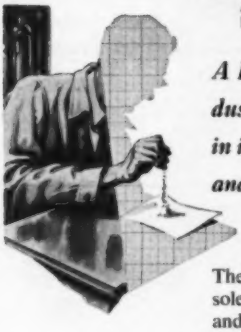
Diesel-powered air compressors are the subject of 24-page brochure 3172-A. A heavy duty, four-cycle diesel engine and a double-acting compressor are combined as a single compact unit. Free air delivery ratings for 100 psi are 335, 700, 1075, and 1450 cfm for sizes using 2, 4, 6 and 8 power cylinders respectively. Suggested applications are listed and numerous actual installations are illustrated with photos. Two large illustrations, one a cutaway, are employed for quick reference in listing design and construction features. Advantages, specifications, and auxiliary equipment are also presented. Ingersoll-Rand Co.



Fly-ash collection can pay its own way



After an exhaustive study, engineers at a Southern paper mill selected Buell van Tongeren Cyclones for their three pulverized-coal-fired boilers.



A Buell industrial 'dust' man can show you how dust collection pays off in improved product, higher employee morale and better community relations

The Buell organization of industrial 'dust' men is devoted solely to the design and construction of dust recovery and dust collection equipment that will most efficiently and economically solve your plant's specific stack dust problem.

For more than 18 years we have been doing just this for all American industry. Every Buell installation is a custom designed system, engineered to hold stack dust discharge down to the practical limits which assure new profits, improved product and/or process, better plant-community relations, higher levels of employee morale.

For full information about Buell's ***3 basic systems*** of dust collection, and how one can be applied to the solution of your stack dust problems, write today. Ask for the new informative bulletin titled, "The Collection and Recovery of Industrial Dusts." Do it now. Buell Engineering Co., Dept. 90-D, 70 Pine Street, New York 5, N. Y.

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HIGH EFFICIENCY CYCLONES • ELECTRIC PRECIPITATORS
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SPECIAL PURPOSE COLLECTORS • DUST HOPPER VALVES

buell

ENGINEERED EFFICIENCY IN DUST COLLECTION

New bulletins and catalogs

(Continued from page 150)

bulletin. Photos and layout drawings illustrate the blender equipment and system, as well as types of installations. Bowser, Inc.

Panelboards **213**

Standard instrument panelboards are illustrated in 4-page folder 143. Units built to specifications are mentioned, and a brief discussion of standard units is included. Falstrom Co.

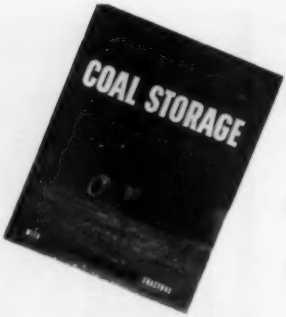
Combustion Instruments **214**

Smoke and combustion instruments and recorders are presented in 8-page bulletin 501. Installation and advantages are discussed and case histories are cited. Diagrams explain automatic control system in which smoke meter controls steam jets or overfire air blowers. Ess Instrument Co.

COAL, ASH & BULK HANDLING

Coal Storage **215**

Economic coal storage using tractor-scrapers, bulldozers and tractor-shovels is outlined in 8-page bulletin MS-872-5012. Photos demonstrate actual use of equipment. Method of stockpiling to lessen danger of storage fires is dia-



gramed, and other advantages of the system are described. Illustrations and specifications for several types of tractor equipment are included. Allis-Chalmers Manufacturing Co.

FANS & BLOWERS

Blowers & Exhausters **216**

Design and construction features of single and multi-stage centrifugal blowers and exhausters are presented in illustrated 24-page brochure 120-B-14. Advantages, operating characteristics and regulation are given. Photos depict numerous actual installations. Roots-Connersville Blower Corp.

FILTERS, STRAINERS & PURIFIERS

Line Type Purifiers **217**

Efficient purifiers for removal of entrained liquids, solids, oil or dirt from steam, vapors or air are featured in 6-page folder 500. The units are designed for vertical or horizontal installation in pipe lines from ½ to 2 in. diam. How they operate, advantages, dimensions and applications are discussed and illustrated. The V. D. Anderson Co.

FUELS & FIRING EQUIPMENT

Fuel Oil Additives **218**

Problems concerned with the burning of modern fuel oils and the application of additives are the subject of a technical folder. Data and information on elimination of sludge, soot and slag in the burning of industrial fuel oil are presented. E. F. Drew & Co., Inc., Power Chemicals Div.

Oil Burners **219**

Oil burners with capacities from 5 to 60 gpm are described and illustrated in 8-page catalog AD-102. Heavier grades of fuel oil, up to No. 5, can be

(Continued on page 154)

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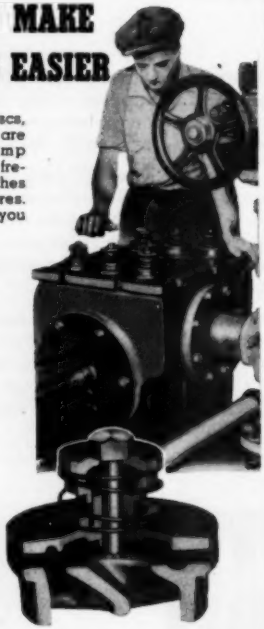
HOW YOU CAN MAKE PUMP REPAIRS EASIER



Worn seats and valve discs, broken springs and stems are eliminated with Sims Pump Valves. Sims valves cure frequent pump repair headaches with exclusive design features. They're **guaranteed** to give you better pump performance.

You get longer service from seats and discs because of rotating disc that changes to a new seating-surface every time it opens. Valves can't hammer up and down.

Inclined rib seat and shock-absorber stem heads combine to permit increased speed without valve-knock. Capacity can be increased 40% and more.

Low resistance through seat reduces turbulence — gives protection against vapor binding.

Long guide gives even lift — reduces wear. Spring is protected against jamming.

Write for new catalog showing how Sims valves fit your pump and give better pump performance.

SIMS PUMP VALVE CO., INC.

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Replace Obsolete Steam-Wasting Units With Illinois Specialties

Equip your radiators with smooth-acting Illinois Supply Valves and sensitive, steam tight Illinois Thermo Traps.

Improve system operation by replacing thermostatic drip traps with Illinois Float and Thermostatic Traps wherever rapid elimination of condensate is essential.

Illinois Float and Thermostatic Traps are made in three Series to meet a wide variety of applications and for operating ranges from 50 pounds pressure to 25 inches vacuum.

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Low Headroom Ram Type

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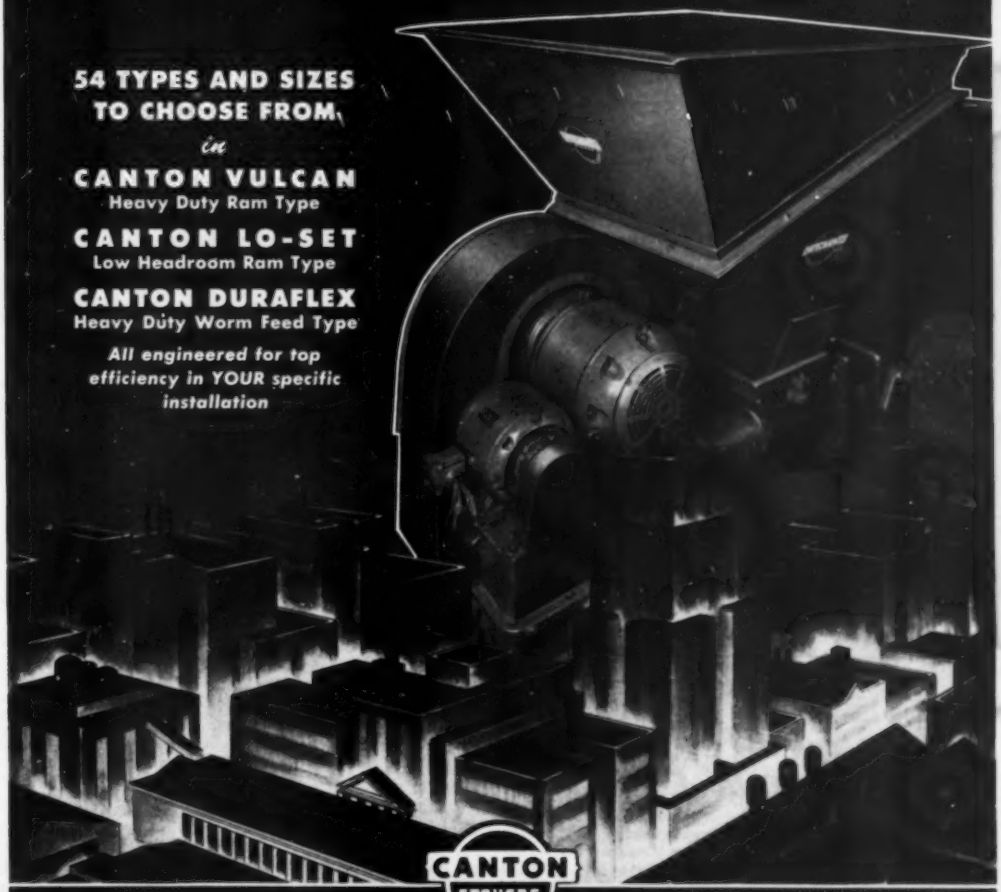
Heavy Duty Worm Feed Type

All engineered for top efficiency in YOUR specific installation



CANTON STOKERS

CANTON STOKER

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SANTA ROSA HOSPITAL, San Antonio, Tex.
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By specifying Kewanee Heavy-Duty Boilers, for 100, 125 or 150 pounds working pressure, large institutions can be certain of dependable heat at all times with an ample reserve for emergencies . . . *plus high pressure steam* for kitchens, laundries, sterilization and other equipment.

Pictured is the Santa Rosa Boiler Room with its battery of 2 Heavy-Duty Kewanees each of 270 HP . . . producing a total of 15,000 lbs. steam hourly.

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Serving home and industry

Heating America's Finest Buildings

KEWANEE BOILERS

New bulletins and catalogs

(Continued from page 152)

utilized. Lists construction features, advantages and specifications. Cleaver-Brooks Co., Hev-E-Oil Burner Div.

Oil Burning System **220**

Principle of operation of a wide range burner control employing a controlled fuel return from the atomizer tip by means of a constant differential pump system is described in 4-page folder 109-B. Advantages are discussed and photos depict actual installations. Peabody Engineering Corp.

HOW TO REQUEST FREE BULLETINS

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DIESEL & ENGINE ACCESSORIES

Crude Oil Purifier **221**

Use of pipe line crude oil as fuel for pumping station diesel engines is possible with a continuous centrifuge described and illustrated in 8-page brochure 1266. Advantages, principle of operation and specifications are included. Recommended storage tank and piping arrangement is illustrated with large flow diagram. Capacities are up to 550 gph. Photos are employed to show actual installations. The Sharples Corporation.

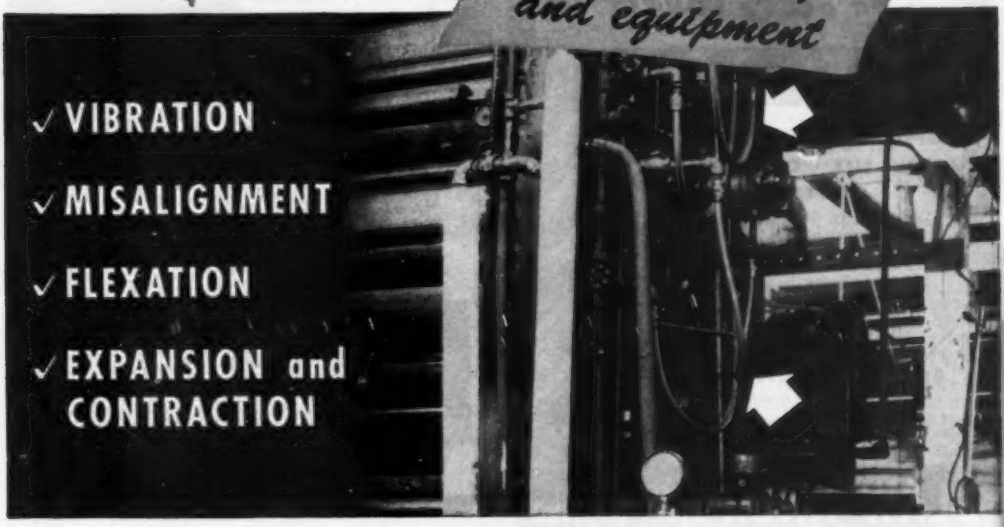
DIESELS

Diesels **222**

Specifications and descriptions of one, two and three cylinder, 4-cycle diesel engines, for continuous duty or standby service, are included in 12-page bulletin 194. These units, rated at 10 to 45 hp within a range of 1200 to 1800 rpm, are offered as self-contained units with generator, pump, or with stubshaft or clutch power take-off for direct connection or belt drive. A large cutaway is used to

(Continued on page 157)

Keep these *Dangerous* stresses *out of piping and equipment*



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CMH Corrugated Flexible Metal Hose can be furnished in steel, bronze, stainless steel and other alloys. Depending on size, type and material, pressures up to 12,000 psi (burst) and temperatures up to 1600° F. can be handled.

CMH Convoluted Metal Hose is made in a variety of types and in steel, bronze and alloys. Depending on size, type and material, pressures up to 500 psi and temperatures up to 600° F. can be handled.

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MOTION or misalignment in rigid piping presents serious problems to the plant engineer. Piping subject to these stresses is in a potentially dangerous condition. In most cases these problems can be economically, dependably and safely solved by using CMH Flexible Metal Hose.

As a manufacturer of a complete line of flexible metal hose, CMH can furnish the type of hose best suited to your needs. CMH distributors are located in principal cities. See your classified telephone directory or write for his name. If you would like to have literature describing the CMH line, write for it, mentioning the types of connection problems you have.

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Flexon identifies CMH products that have served industry for over 50 years.

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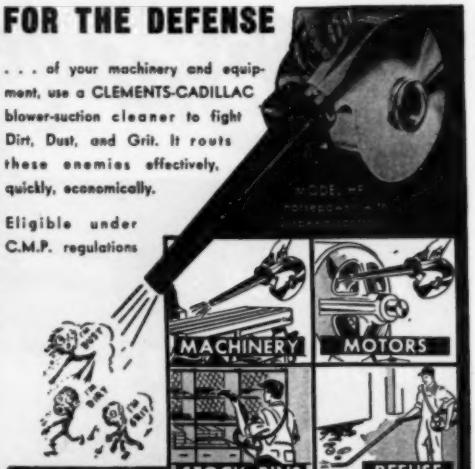
Eligible under C.M.P. regulations



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TYPE-GGU Aurora Side Suction Centrifugal Pump.

For Every Purpose

APCO Turbine-Type PUMPS
—Ideal for "1001" duties where small capacities and high heads predominate. Get acquainted.

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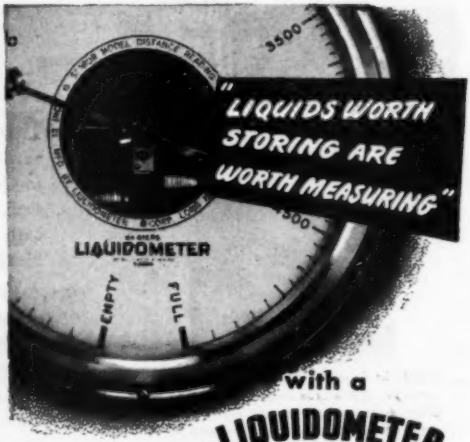

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THE **LIQUIDOMETER** CORP.
36-32 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

New bulletins and catalogs

(Continued from page 154)

show construction features. In addition, all main engine parts are illustrated and described. Specific applications are listed. Nordberg Mfg. Co.

LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

Moly-Sulfide Lubricant **223**

Moly-sulfide lubricant is discussed in a 38-page booklet. It is well suited for assembly and disassembly of closely fitted parts, as a lubricant in hot and cold working and forming of metals, as a lubricant for high and low temperatures, as a non-dust-collecting lubricant and as a dielectric lubricant. Specific applications and recommended forms are listed in quick reference tables. Climax Molybdenum Co.

HYDRAULIC EQUIPMENT

Air & Hydraulic Circuits **224**

"The Circuit Rider," 32-page pocket-size manual, presents a discussion of basic designs for fluid power circuits. Drawings and list of standard symbols are included. This manual endeavors to bring to industry a down-to-earth explanation of representative types of fluid power circuits, and to show the many

possibilities afforded through the use of different types of circuit designs. Logansport Machine Co.

JIC Symbols Guide *

If your work involves industrial hydraulics, the "JICircuit Guide" may be a convenient and valuable tool. This kit gives a quick and complete key to all standard Joint Industry Conference symbols for industrial hydraulics. The kit is made up of two units—a plastic template containing basic elements of all symbols, and a 32-page booklet in which all key examples of circuit components are represented by symbols. Accompanying each symbol is a reference to the manufacturer's catalog describing that particular piece of equipment. *This kit may be obtained by sending requests on company letterhead directly to The Denison Engineering Co., Dept IP, Columbus, Ohio.

HOW TO REQUEST FREE BULLETINS

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MAGNETIC SEPARATORS

Magnetic Flow Trap **225**

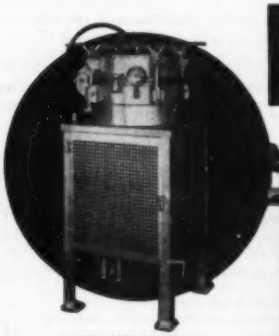
Catalog sheet 1151 describes and illustrates magnetic full-flow trap to remove tramp iron from liquid conveying lines. Design features, specifications, and prices are presented, as well as information on how to order. Tri-Clover Machine Co.

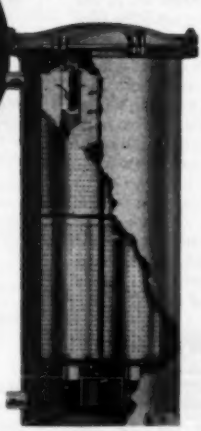
MATERIALS OF CONSTRUCTION

Self-Lubricating Materials **226**

Carbon or graphite impregnated with babbitt, copper, cadmium, or silver is described in 4-page folder. It is used for bearings, bushings and wearing parts where oil or other lubrication is undesirable. It can also be used for electrical contacts or motor brushes. Properties, advantages, applications and engineering data including mechanical characteristics are presented. The Carbone Corp.

(Continued on page 158)


OIL RECLAIMER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SAFETY FIRST!

and SPEED...and ACCURACY with Snap-on Tools

Ever think of this — that nearly every machinery maintenance job starts and ends with *wrench-work?* For instance, the nuts that hold the bearing housing of this diesel-electric traction motor to the motor frame must be pulled up *tight*... which means they come off plenty hard! How could you beat a Snap-on ratchet, such as this husky, big-leverage L-73, for safe, fast, nut turning on jobs like this?

As a matter of fact (a fact which tens of thousands of good mechanics will attest) you can't beat a kit of Snap-on Tools for handling the whole normal range of machine maintenance work. Snap-on Tools are *engineered* to help a man do his best work faster and easier. That's why Snap-on's specialized Railroad Service is welcomed in railroad shops the country over. His job is to be helpful... *and he is!*

Write for industrial catalog and 104-page general catalog!

*Snap-on is the trademark of Snap-on Tools Corporation.

SNAP-ON TOOLS CORPORATION
8102-D 28th Avenue
Kenosha, Wisconsin

New bulletins and catalogs

(Continued from page 157)

HEAT EXCHANGER EQUIPMENT

Cooling Towers **227**

Packaged redwood cooling towers are described in illustrated 4-page folder 5.9.083. Units are prefabricated for easy field assembly. In addition to listing advantages and specifications, the bulletin offers data and charts to aid in selection of equipment. J. F. Pritchard & Co., Equipment Div.

Heat Exchangers **228**

Heat exchangers in relation to their use for heating and cooling, condensing and for evaporating are presented in 8-page bulletin. Cross-sections of heads, shells and tube bundles together with brief descriptions and recommended applications are given. Tank heaters and fuel oil heaters are also described. Superior Combustion Industries, Inc.

HOW TO REQUEST FREE BULLETINS

Insert "key" numbers on return post card found on page 131. Our Reader's Service Department will handle your request promptly

ELECTRICAL DISTRIBUTION

General Catalog **229**

Rheostats, resistors, relays, starters, contactors and dimmers are listed in 8-page bulletin 100,000. Each is illustrated for quick reference and bulletin for each specific type is listed. Includes brief descriptions of construction features, advantages, applications and specifications. Ward Leonard Electric Co.

Electrical Data Book *

Detailed information on almost any type of electrical equipment is readily accessible in revised edition of "Architects' and Engineers' Data Book." This 330-page book B-2161-E is divided into three general equipment categories of power plant, electrical distribution, and utilization and accessory equipment. A fourth section on engineering data deals mainly with product application and design of distribution systems. Full information for each piece of apparatus is presented, including illustrations, charts and technical data. ***This book may be obtained from the nearest district office of Westinghouse Electric Corp.**

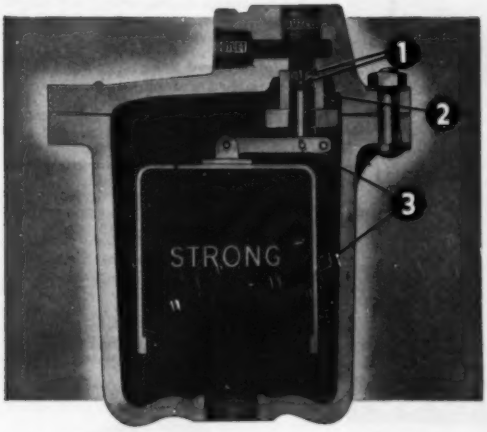
MOTORS & GENERATORS

Motor-Generators **230**

Low-voltage d-c motor generators for electrolytic processes are the subject of 14-page bulletin 20-210. Sleeve-bearing and ball-bearing constructions are presented. Details of construction are described and well illustrated with

(Continued on page 160)

3 Reasons STRONG* Traps are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

, Catalog No. 68-J describes inverted, open bucket and other types of STRONG traps. Write today. Send for Catalog 68-J today! *Trade Mark Reg. U. S. Pat. Off.

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ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

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70 Series Trap

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STRONG

THIS G-E CLEANER Helps you Save Money Helps you Save Time

THESE modern, G-E Heavy-duty Cleaners have many special features:

- They help you cut cleaning time . . . a sure way to cut maintenance costs.
- They switch quickly and easily from wet to dry pickup . . . powerful motors pick up mop water, dust, coarse litter with equal ease.
- They have extra-wide nozzles to cut the cleaning time of larger areas.
- They convert in a moment to *powerful blowers* for quick gathering of scrap into convenient piles for salvage or disposal.
- They have special attachments for cleaning high, hard-to-reach areas thoroughly and quickly.

These are but a few of the features that make G-E industrial cleaning equipment so productive.

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1285 Boston Ave., Bridgeport 2, Conn.

Without obligation, please send complete details on heavy-duty cleaning equipment.

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FIRM _____

ADDRESS _____

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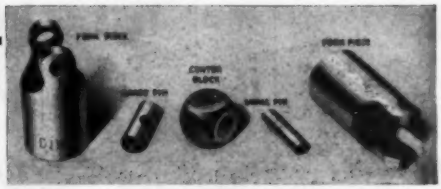

What's Your Angle . . .

LOVEJOY
UNIVERSAL JOINTS
FIT THEM ALL!

For the greatest operating angle with maximum bearing surface and strength, always use Lovejoy Universal Joints. Operation is smoother — there's no binding, backlash or end play. Precision-ground of heat-treated alloy steel to .001 concentricity. Rivets ground flush with body for close work. Exceed Armed Forces rigid requirements. Available in 13 sizes with diameters ½" to 4" and lengths 2" to 10 5/8".

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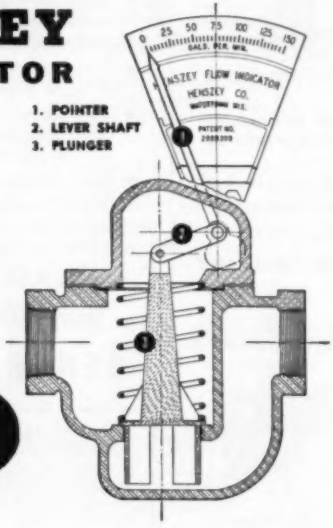
Manufacturers of Lovejoy Flexible Couplings and Variable Speed Controls

Only 3 **MOVING PARTS** *in the* **HENSZEY**
FLOW INDICATOR

There are only three moving parts in the Henszey Flow Indicator—the Pointer, the Lever Shaft and the Plunger. And that means longer wear, continued service, and constant accuracy.

The liquid enters the indicator below the plunger, forcing the plunger upward. Slots in the side of the plunger allow the liquid to pass. Increased flow will increase the lift, exposing a greater area of the slots, so that the lift of the plunger is in direct proportion to the rate of flow of the liquid. The graduations on the dial are uniformly spaced from one end to another and read direct—without constants. The entire instrument can be installed right in the pipe line.

1. POINTER
2. LEVER SHAFT
3. PLUNGER



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FLOW INDICATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

New bulletins and catalogs

(Continued from page 158)

photos. A brief history of development is also related. Includes electroplating fundamentals dealing with efficiency, reserve capacity and effect of power factor. The Electric Products Co.

Variable Speed Units **231**

Variable speed motor drives are described in 16-page bulletin 1515-100M. Typical uses, advantages and performance characteristics are listed and photos are employed to show installations. Construction and design features are discussed and illustrated with cutaways and cross section drawings in 4 colors. Speed can be increased as much as 700 per cent. Units with speeds from 1 to 10,000 rpm are listed from ¼ to 50 hp. U. S. Electrical Motors Inc.

Induction Motors **232**

Design and application features of steel frame a-c induction motors from 20 to 700 hp are described in 20-page booklet B-4731. Separate sections de-

scribe and illustrate construction of motor frames, end brackets, stators, rotors and bearings. Ventilation system is also discussed. Standard and special mountings and enclosures are described. Photos show actual installations in many industries. Westinghouse Electric Corp., Motor and Control Div.

General Catalog **233**

"Equipment for Power Plant and Industry," 20-page bulletin Q-14, presents brief descriptions and illustrations on a variety of equipment. Divided into two sections, the first part discusses steam turbines, condensers, ejectors, turbochargers, tube cleaners, centrifugal blowers, deaerating heaters and strainers. The second covers a-c and d-c motors and generators, motor-generator sets, synchronous condensers and couplings. Elliott Co.

Explosion-Proof Motors **234**

Construction details of explosion-proof motors are described in bulletin 51B7286A. They are available in non-ventilated types from ½ to 2 hp, and in fan-cooled types from 3 to 100 hp. They are Underwriters' approved for use in

Class I, Group D, and Class II, Groups F and G atmospheres. Allis-Chalmers Mfg. Co.

MECHANICAL POWER TRANSMISSION

Bearings 235

Information on bearing load computation and charts of load formulas are contained in 136-page bearing selection guide. Factors influencing bearing selection are analyzed and examples are given covering their use in determining load. Sections of the book are indexed for quick reference. One section is devoted to engineering data. Others deal with bearing types, such as ball bearing, full roller and cageless guided roller. McGill Manufacturing Co., Inc.

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PACKINGS & GASKETS

Metallic Packings 236

Illustrations and descriptions of flexible metallic packings are presented in 8-page bulletin. Included are service recommendations and illustration of "V" metal insert packings, metallic valve stem, plastic core metallic face, all metallic, flexible metallic, high temperature aluminum, and braided copper packings. Standard sizes, packages and approximate weights for each type are also listed. Raybestos-Manhattan Inc. Packing Div.

PIPE & FITTINGS

Swivel Joints 237

Ball-bearing swivel joints are illustrated and described in 18-page catalog 51-D. In addition to general purpose models, units for special conditions such as high pressures and temperatures and for handling corrosive liquids are presented. Units such as rotary hose, cementing and circulating hose, marine and barge hose, mud mixing guns and circulating heads are also included. Specifications for each are listed. Catalog is indexed for quick reference. Chiksan Co.

Welding Fittings 238

Welding fittings for use with stainless steel light gage O. D. tubing are described and illustrated in 16-page catalog 748. Fabrication, advantages, analysis, theoretical bursting pressures, complete list of dimensions and how to order are discussed. Also gives useful table on friction of water in pipes. Price lists are included. Tri-Clover Machine Co.

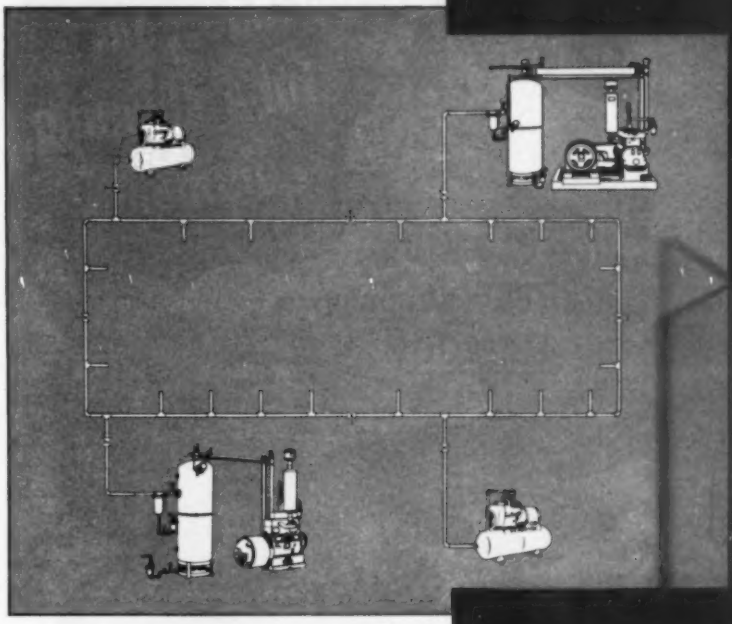
STEAM SPECIALTIES

Steam Traps 239

Float and thermostatic steam traps for vacuum or pressure service and float type for pressure only are the subject of illustrated 4-page folder 514. Capaci-

(Continued on page 182)

HOW TO SAVE MONEY ON YOUR... AIR COMPRESSOR INSTALLATION



SCHRAMM UNIT SYSTEM

The perfect, money-saving, "inside-the-plant" air compressor installation is the Schramm unit system . . . whereby, in a minimum of space, you install one, two, three or more Schramm air compressors, according to your air needs, and operate them singly, or separately, as the load requires. Here is how such an installation saves you money:

1. Low In Initial Cost. No foundation cost, cuts by half the installation price. Can be transported into the plant on standard material handling equipment, set in place, grouted, bolted down, ready for use in matter of hours!

2. Low in operating cost. The losses when operating a large compressor at light load are very great. On the other hand, the vertical compressors in unit system can be equipped with automatic start and stop control, set at proper pressure ranges, so as to regulate the air output according to load demand. Unit system installations allow you to use one, or as many of the compressors as you need.

3. Low in maintenance cost. The unit system allows you, when one of the compressors is shut down for minor repairs, to continue operating the other compressors without affecting the overall capacity of the plant to any appreciable extent. *For full details write us today.*

SCHRAMM, INC.

The Compressor People

WEST CHESTER • PENNSYLVANIA

SCHRAMM INDUSTRIAL AIR COMPRESSORS

Use CADMIUM PLATED equipment by AIRETOOL

Now, you can protect your tube cleaning equipment against the costly effects of corrosion. AIRETOOL has developed a process of Cadmium plating the tube cleaning equipment which makes them acid resistant and keeps them in service many extra years.

AIRETOOL forwardly arm tube cleaner for removing heavy scale from curved tubes.

AIRETOOL ball bearing type expander for perfect results when expanding tube ends into tube sheets.

This is further evidence of AIRETOOL'S leadership in designing tube maintenance equipment which meets present day industrial problems. AIRETOOL expanders, too, are designed with your tube rolling problems in mind. If you are interested in higher production and in lower tube maintenance costs—order in a supply of AIRETOOL tube cleaners, tube expanders and accessory tools. For specific details, write The AIRETOOL Mfg. Co., 318 S. Center St., Springfield, Ohio.

There's an AIRETOOL Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

BRANCH OFFICES:
New York, Philadelphia, Chicago, Tulsa, Baton Rouge, Houston.

REPRESENTATIVES in Principal Cities of U.S.A., Canada, Mexico, South America and England.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

New bulletins and catalogs

(Continued from page 161)

ties, listed in chart form, are to 3390 lb of water per hour with pressures to 125 psi. Dimensions, weights and prices are also listed. American District Steam Co., Inc.

PUMPS

Proportioning Pumps **240**

A high pressure, low capacity, reciprocating plunger pump, designed for applications requiring a controlled capacity of fluid, is the subject of a 4-page bulletin. Construction features are illustrated by a cross section drawing. Specifications and application data are presented. Capacities to 14.6 gph are listed for various pressures. Chemical feed packaged unit combining a

chemical storage tank and proportioning pump is also presented. It is suited for feeding boiler water treatments as well as delivering chemicals and other fluids for processing. The tank is available in either 50 or 100 gal size. The Bird-Archer Co.

Process Pump **241**

Bulletin B-1605, 4 pages, features cutaway view pointing out design details of a heavy duty, horizontal center-line mounted process pump. Units are offered with capacities to 1000 gpm, heads to 625 ft and temperatures to 850 F. Types of drive and materials of construction are listed. Dimensions are given in chart form. Food Machinery & Chemical Corp., Peerless Pump Div.

Centrifugal Pumps **242**

Advantages, efficiency construction features and dimensions of single stage, double suction centrifugal pumps are discussed in 6-page folder 240. Capacities are from 50 to 600 gpm. Large cutaway is employed to show component parts. Table shows proper sized pump and required horsepower for varying heads and capacities. Warren Steam Pump Co., Inc.

Sump Pumps **243**

Centrifugal sump pumps, wet and dry pit types, for sewage, clear liquids

or liquids containing solids are the subject of 8-page bulletin WQ-220. Eight sizes from 1½ to 8 in. are offered with capacities to 2000 gpm and heads to 120 ft. Descriptions of pumps as well as specifications and dimensions are presented. Illustrations include photos and line drawings. A table gives approximate pump and motor sizes at various speeds. Warren Steam Pump Co., Inc.

Pump Valves **244**

Pump valves and graphitic packings are discussed and illustrated in 24-page brochure SC-510. Types, details of construction, design features, applications, how to order and dimensions are included. Heaters for heating water by blending with steam are also presented. A quick reference index adds to the booklet's usefulness. Sims Pump Valve Co., Inc.

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REFRACTORY CONCRETES

Heat Resistant Concrete **245**

Useful engineering data and information pertinent to the structural design of refractory and heat-resistant concrete is contained in illustrated 12-page booklet PP-5M. Subjects such as strength, volume changes, methods of reinforcing, sprung arches and domes, application to ducts, and stack linings are dealt with. Universal Atlas Cement Co., Lumnite Div.

Refractories & Insulations **246**

Catalogs R-52 through I-93, compiled in binder, form an illustrated 40-page booklet showing where, when and how to use various types of refractory and insulation materials for industrial heat generating and processing equipment. Of particular interest is a table showing how to select proper insulation thickness. Contains helpful suggestions that should aid in solving refractory and insulation problems. An index is included for quick reference. Refractory & Insulation Corp.

Refractories **247**

Charts which show at a glance the properties of refractory castables, plastics and mortars are featured in 20-page catalog R-22. Important information including recommendations for each is presented. Photos depict application and end results. The Babcock & Wilcox Co., Refractories Div.

Refractories **248**

Hydraulic setting refractories for casting special refractory shapes and for gunning and slap troweling applications are the subject of 12-page brochure RC-28A. In addition to discussion of advantages, applications and specifications, the booklet also contains suggestions for solving maintenance problems and recommendations for casting shapes and linings. Photos show typical uses and illustrate handling methods. Johns-Manville.

(Continued on page 164)

DART

...the Union that is its own Best "Replacement"!

(YOU CAN USE ONE OVER AND OVER AGAIN)

Yes, you can take a Dart off one installation and put it on another. Or put it back on the same installation—time after time. That's economy!

Here's why you can get so much work out of a Dart:

- ***Drop-Tight Yet "Easy Does It"***
  Dart's spherically ground seats provide a wide, full bearing surface that requires a minimum of nut take up. Excessive wrenching (hard on metal and man) isn't required. What's more, a Dart *stays* tight.
- ***Non-Corrosive Bronze Seats***
  Why do they use bronze for memorial plaques? Because it *lasts!* That's why *we* use this non-corrosive metal for protection of seats against pitting and corrosion.
- ***Practically Indestructible Nut and Ends***
  Air refined malleable iron is tops for resistance to stress, stretching and wrenching. That's why we use it for Dart nuts and ends.

Test a Dart on your next job. You'll *like* its quicker, easier action — you'll *save* by its longer working life!

DART UNION COMPANY
Providence 5, Rhode Island
The Fairbanks Co. — Distributors
Boston New York Pittsburgh

DART
UNIONS

Monolithic R & I Moldit refractory car bottom and special precast piers, has outlasted fire brick many times.

when you need refractory shapes in a hurry

Better Cast 'Em of MOLDIT Refractory Cement

Boiler Tube Tile

Pier for Spreader Stoker

Burner Tile

Boiler Sidewall Tile

Save Time and Cost on Shapes of Any Type or Size

Whether it's large, monolithic wall sections, baffles, arches, linings or smaller precast shapes of various types—you can definitely put an end to refractory replacement or repair worries with R & I Moldit Refractory Cements.

It takes no great skill to make or install Moldit shapes. Any replacement or repair, large or small, can be poured or cast, air cured and put into service in a few hours.

Make them as you need them, or, if you prefer, we can precast them in any shape, size and quantity—and ship quickly.

Moldit Castables are strong at high and low temperatures. No spalling, no shrinkage; entirely water resistant. They're more efficient than fire brick; lighter, stronger. There's a Moldit Cement for just your needs.

Try Moldit, America's leading quality castable refractory, on your next job. Learn more about it. Write for Catalog R-52.

REFRACTORY & INSULATION CORPORATION

118 Wall Street • New York 5, N. Y.

Manufacturers of Refractory Castable and Bonding Cements Insulating Block, Blankets and Cements

New bulletins and catalogs

(Continued from page 163)

TOOLS

Tube Expanders **249**

Rolling and flaring tube expanders and operating accessories are listed in illustrated 8-page catalog 68. General information, specifications and recommendations are included. A useful guide for ordering is also presented. The Gustav Wiedeke Co.

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Tube Cleaners **250**

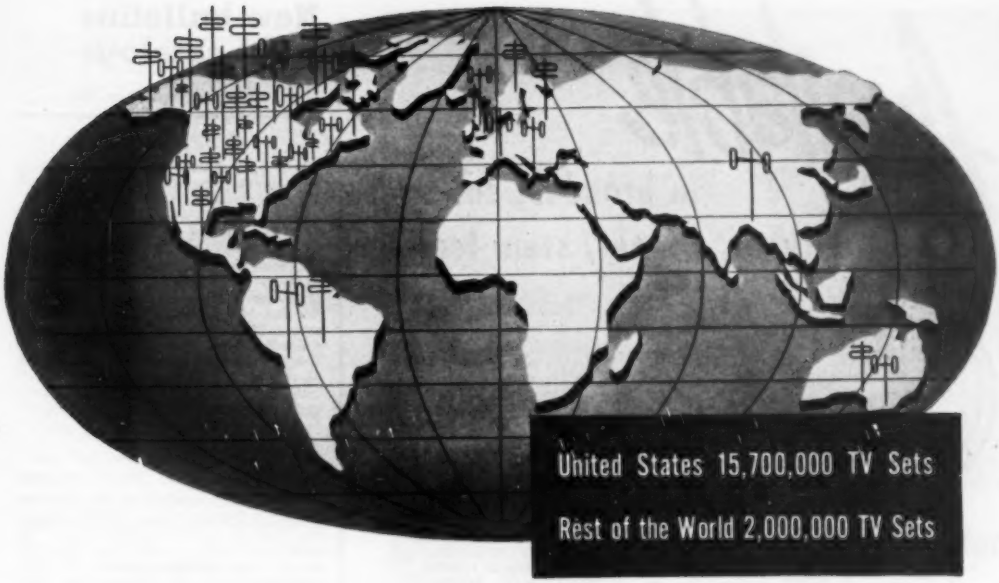
Equipment for practically every tube cleaning operation is presented in 28-page catalog Y-29. Specifications for cutter heads, drills, brushes and motors are listed in illustrated tables for quick reference. Cutaways show design features of air, steam, water and electric powered motors. Various applications of standard equipment, as well as a few

special applications, are discussed and illustrated. Accessories such as lubricators, valves, operating hose and couplings are also presented. A section on care and operation of tube cleaners and also a table of inside diameters for varying tube and pipe sizes add to the booklet's value. Elliott Co., Lagonda Div.

Pipe Tools **251**

Pertinent information on power operated pipe and bolt machines, ratchet threaders, reamers, cutters and other pipe tools in the hand and the power classification is given in 28-page 1952 catalog. Four pages are devoted to an instructive operating guide prepared to aid users in obtaining best results from equipment. Drawings and technical

(Continued on page 166)



COMPETITION Turns Luxuries into Necessities

Two millions of people throughout the world, washing machines, radios and television sets are miraculous inventions remote from their lives . . . for the wealthy only.

In the United States, however, a new product appears in no time in the homes of wage earners as well as salaried executives.

Consider television, for example. Only 6,500 sets produced in 1946 . . . over 5,000,000 in 1951. Or washing machines . . . more than 24,000,000 in 10 years.

What has Competition to do with this?

Do you think we'd continue to get more and better products if only one company made each item or each line?

No! We get more and better products here in America, because anybody who thinks he can make anything better or sell it more efficiently is free to try.

And many succeed. Take electrical products like radios and television sets . . . and home appliances like washing machines and electric fans. Does the biggest company monopolize this industry? Not by a long shot! Even counting all its affiliated companies, it still sells less than 1/5 of such products bought in this country.

There are nearly a thousand other companies that make home appliances, radios and television sets. And they do more than 4/5's of the business! The smallest of them make the biggest companies hustle their bones to keep making products better and better.

In America, a better product can always win consumer acceptance in any field.

Let's keep the COMPETITIVE SYSTEM working for us

The Competitive System can be killed! When industries are run by government, when taxes are so high that they destroy the incentive to work hard and risk savings in business ventures, the Competitive System languishes and dies.

You've seen it happen in other lands. Let's not let it happen here.

Let's all of us watch closely to see that those who represent us in government are working with us and for us to preserve our Competitive System; to assure a tax structure that leaves enough incentive to make hard work worthwhile, so that *any* man with ability and energy has a chance to earn good money and keep most of it.

Competition thrives best where the rewards are high. People live best where competition thrives.

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THE COMPETITIVE SYSTEM DELIVERS THE MOST TO THE GREATEST NUMBER OF PEOPLE

Available

in broadest selection of types, ranges, stem lengths

TYPE	SCALE LENGTH	RANGES		STEM LENGTH		% ACCURACY OF THERMO. RANGE
		As low as	As high as	As short as	As long as	
Heavy Duty Straight Form	9"	—100F	+1000F	2½"	48"	1
Heavy Duty Angle Form	9 or 12"	—100F	+1000F	2½"	72"	1
Standard Angle Form	6"	—100F	+1000F	2½"	72"	1
General Purpose	4½"	—100F	+1000F	2½"	36"	1
Laboratory	3.40"	—100F	+500F	2"	24"	½ of 1

WESTON

all-metal THERMOMETERS

WESTON Thermometers give you *all* the advantages of all-metal construction *to an unmatched degree.* The durability of stainless steel stems . . . the readability of large, boldly marked scales . . . the sustained accuracy due to precision manufacture *proved* through the years. Order through your regular jobber, or your local WESTON Representative. Catalog T-13 on request . . . WESTON Electrical Instrument Corporation 617 Frelinghuysen Avenue, Newark 5, New Jersey . . . *manufacturers of Weston and TAGliabue Instruments.*

WESTON *Temperature Instruments* INDICATE—RECORD—CONTROL

9236

New bulletins and catalogs

(Continued from page 164)

discussions quickly tell how to locate and correct pipe tool troubles. Beaver Pipe Tools, Inc.

Band Tools **252**

Simplified methods for selecting and operating band tools and machines for sawing, slicing, grinding, filing and polishing are presented in a 160-page manual. This illustrated leatherette bound book is indexed and prepared throughout for quick, easy reference. Chapters include discussion of research service, tables of terminology, types of units, performance, setting up the units and selection charts. The DoAll Co.

TURBINES

Impulse Turbines **253**

Turbines for mechanical drive are the subject of 8-page booklet 4110-A. Ranging from ¾ to 200 hp, they are of the impulse multiple velocity stage type, and may be used with steam, gas or air. Construction details are discussed and illustrated with photos, cutaways and cross section drawings. Information on principles of operation, general description, applications, material specifications, how to select and how to order is also presented. The Pyle-National Co.

TRANSFORMERS

Tap Changing **254**

"Parallel Tap Changing Under Load," 8-page reprint 4776, describes the basic methods of parallel tap changing under load. The latest method, step-by-step switch control, is included. The basis of operation for each method is explained and a chart compares advantages and disadvantages of each. Illustrations of equipment are also included. Westinghouse Electric Corp., Transformer Div.

VALVES

Butterfly Valves **255**

Air-operated butterfly valves and diaphragm operators are the subject of 12-page catalog 1700. Specifications,

construction details, dimensions for mounting and operating characteristics are listed. Illustrations include photos and line drawings. Easy-to-follow selecting and ordering information is also presented. Minneapolis-Honeywell Regulator Co., Brown Instruments Div.

Bronze Valves **256**

Cutaway views point out design details of composition disc bronze valves presented in a 4-page folder. Globe and angle valves, lift checks, spring loaded check valves, and stop and check valves featuring interchangeability are listed. Specification tables list valve sizes from ⅛ to 3 in. for 150 psi steam, 300 psi air or cold water and 375 psi hydrostatic shell test pressure. The Fairbanks Co.

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WATER TREATMENT

Deaerator **257**

Description of a deaerator with internal direct contact vent condenser is given in 4-page folder 3677. Cutaway view is employed to show construction features and principles of operation. The Permutit Co.

Ion Exchanger **258**

Advantages and applications of an alkalinity-reducing ion exchanger which does not require acid for regeneration are presented in data sheet 28X7808. A graphic comparison of water conditioning methods illustrates simplicity of the unit. Allis-Chalmers Manufacturing Co.

Water Conditioning **259**

Water conditioning equipment including demineralizers, dealkalizers, softeners, deaerating heaters, degasifiers, filters and storage tanks are listed in 4-page folder. Arranged for quick reference, each item contains illustration and brief discussion. Penfield Manufacturing Co., Inc.

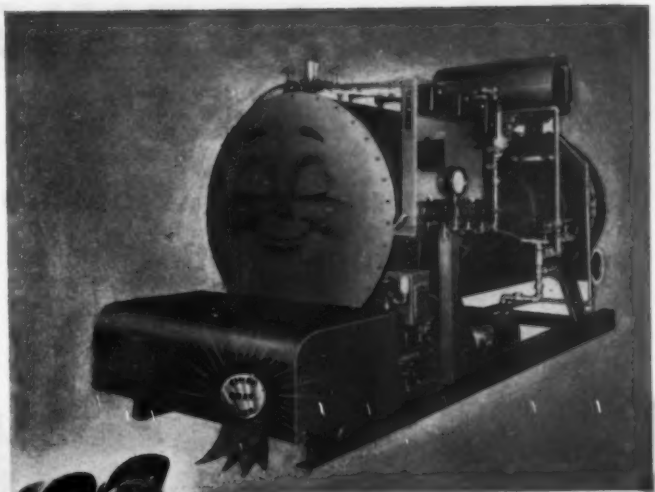
Hot Process Softeners **260**

How they work, advantages, and applications for hot process water softeners are presented in 32-page bulletin 2341. In addition to diagrams to show piping arrangements for various systems, cutaways and photos are also used to illustrate the units. Special applications, description of parts, control valves, electrochemical solution feeders, supplementary treatments, test equipment and instrumentation are also dealt with. The Permutit Co.

Water Conditioning **261**

Methods of conditioning water and purposes served by each are covered in illustrated 20-page bulletin 611. How to make any water softener deliver from three to ten times more soft water is described. Improved water softener and

(Continued on page 168)



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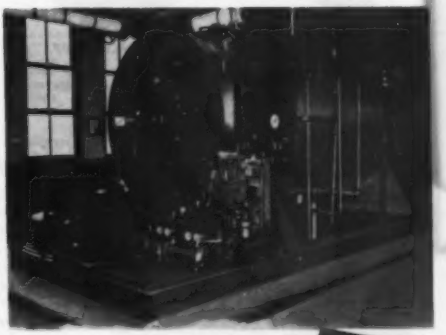

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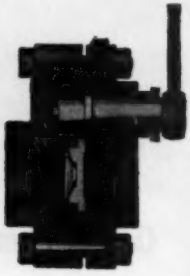

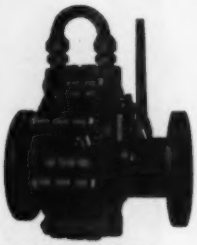

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New bulletins and catalogs

(Continued from page 167)

deionizer of single-tank design are featured. Chemical feed, zeolite post treatment and alkalinity neautralization, and split-stream dealkalization systems for boiler, process and general water conditioning purposes are covered. Sections are devoted to latest type filters, purifiers, degasitors, zeolites and ion exchange resins. Elgin Softener Corp.

WELDING & CUTTING EQUIPMENT

Welding Electrodes **262**

If you are concerned with welding you may find 16-page welding alloys directory of interest. Contains photos, data and technical information on welding alloys for use on numerous metals and for cutting all metals. Includes chart of over 100 different welding alloys, their main uses, bonding temperatures and tensile strengths plus useful ideas on effective uses of welding. Eutectic Welding Alloys Corp.

HOW TO REQUEST FREE BULLETINS

Insert "key" numbers on return post card found on page 131. Our Reader's Service Department will handle your request promptly

Stud Welding **263**

"Maintaining Your Stud Welder," 12-page booklet 1003CC, is devoted to the maintenance of stud welding equipment. Divided into three sections; the first contains general information on how the stud gun and controls work, circuit and wiring diagrams and common troubles—cause and correction. The second section tells how to maintain the gun and component parts of the control mechanisms, and the third section lists accessories. KSM Products, Inc.

Welding Rods **264**

Applications and procedures for production and repair welding, and for building up worn surfaces with bronze rods are suggested in 24-page booklet B-13. Welding techniques discussed include the oxyacetylene torch, metal-arc, carbon-arc, and inert-gas-shielded arc. Tabular data on copper and copper alloy welding rods are also included. The American Brass Co.

MISCELLANEOUS

Sound Control **265**

Series of 1-page data sheets depict various phases of sound control. Included are portable sound barriers, machinery enclosures, sound traps, soundproof rooms and transformer enclosures. Each is briefly described and illustrated with photos. Recommended applications are also given. Industrial Sound Control, Inc.

—End

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ERRATA

Formula on page 99 of the March 1952 issue of INDUSTRY & POWER should read as follows:

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For your handy reference file, following articles, free of charge:

"Practical Considerations in Applying Axial-Flow and Mixed-Flow Pumps", Sept., 1951
"How to Select the Correct Steam Trap", Jan., 1950
"How to Select Corrugated Expansion Joints", June, 1950
"Instruments to Fit the Job", Feb., 1952
"Synchrotie Drives in Process Industries", Oct., 1951
"Proper Maintenance Procedure Means Longer Bearing Service", Sept., 1951
"Syncronous Motors Do Two Jobs at One Time", Feb., 1950
"Low Cost Auxiliary Power from Turbine Drives", April, 1950
"Sprague Electric Meets Steam Demand of Two Plants with Central Unit", Nov., 1951
"Boiler Houses Are Not Necessary Evils", Feb., 1950
"Cooling System Layouts for Best Diesel Performance", Sept., 1951
"Diesels in A Hydroelectric System", June, 1950
"Maintenance 'Know How' Means Efficient Batteries", Aug., 1951
"Warm and Cold Tank System for Multiple Station Cooling", Nov., 1951
"Proper Water Tower Means Water Conservation", April, 1951
"Water Conditions and Water Conditioning at Titus", Mar., 1952
"Modern Fuel Oils and the Application of Additives", Oct., 1951
"Correct Plans Consider Future Expansion Too", Dec., 1950
"Engineers' Handbook", Volumes 60 and 61, 1951
"Modern System Moves 600 Ton of Coal per Hour", Feb., 1952

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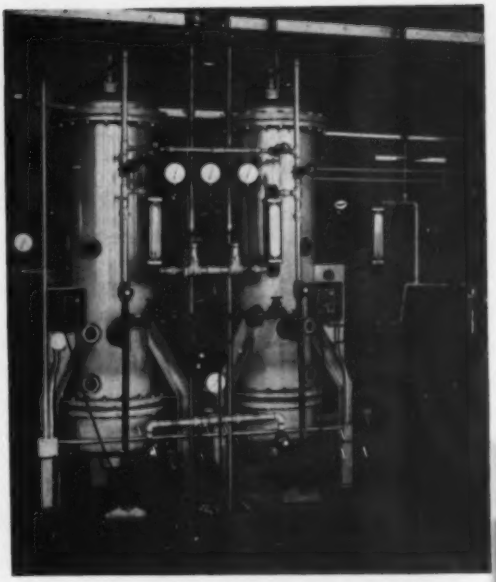

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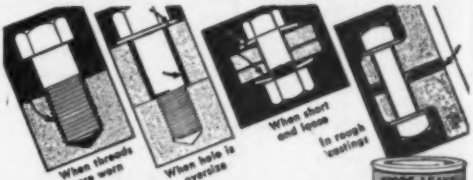

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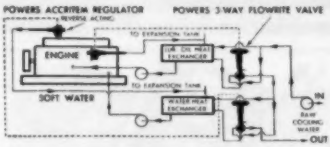
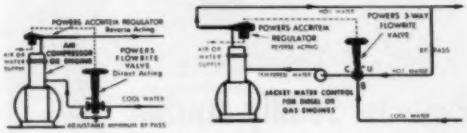


Only a few of many possible applications



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Write for Bulletin 316 (a02)

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This **CURVE-TUBE MOTOR**

gives up to

40% more power

while "taking the curves"

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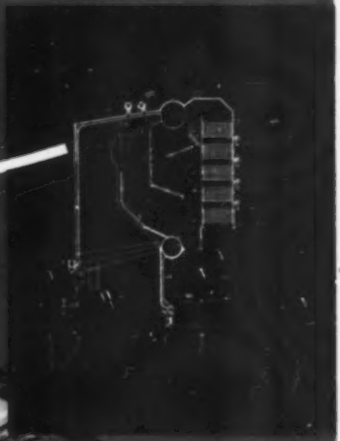
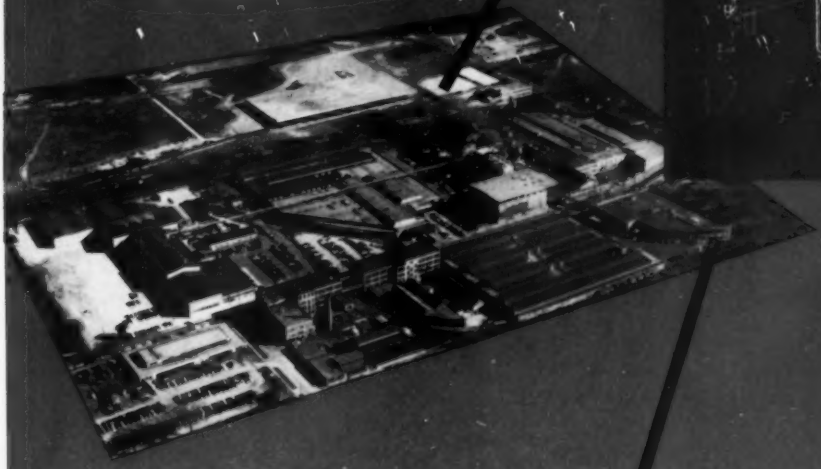
SUTHERLAND PAPER COMPANY Installs 12th WICKES STEAM GENERATOR





The new WICKES boiler in SUTHERLAND'S Michigan plant produces 120,000 lbs. steam per hour at 475 lbs. pressure and final steam temperature of 650° F.

Like so many industries and institutions that require steam, the SUTHERLAND PAPER COMPANY with plants in Kalamazoo, Michigan, and Santa Clara, California, has learned to depend on WICKES for efficient steam production. That's why they've just installed their twelfth WICKES boiler in 35 years of successful paperboard manufacture. The new WICKES boiler at the SUTHERLAND PAPER COMPANY is fired by spreader stoker but these units are readily adaptable to any standard method of firing. It is equipped with a superheater and an economizer and the design makes it especially practical where space is limited. WICKES can fill your needs for steam generators up to 250,000 lbs. per hour and 1000 psi. Write today for descriptive literature or consult your nearest WICKES representative.

WICKES

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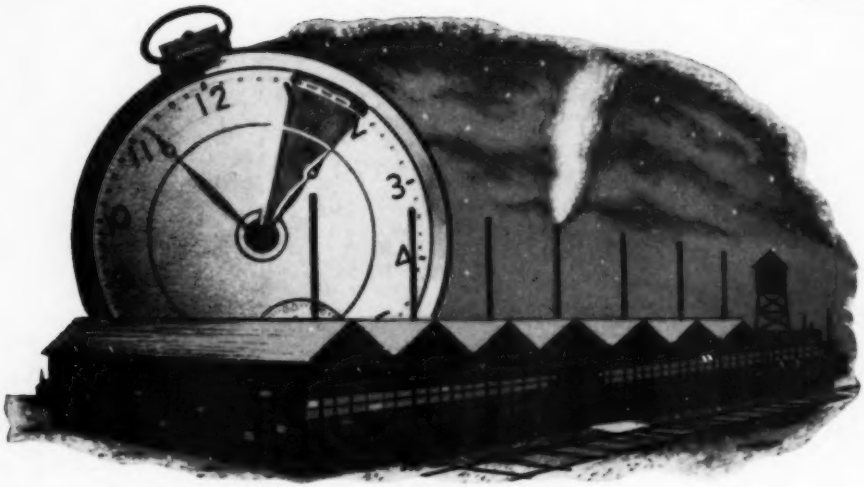

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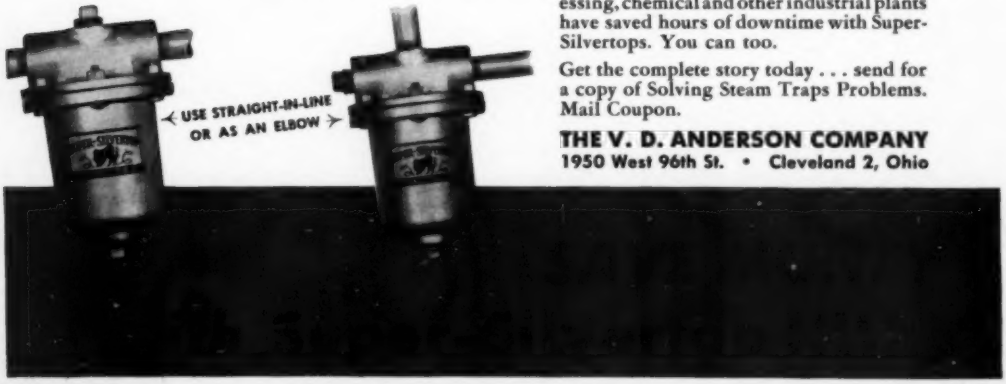

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